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SAMPLING AND ANALYSIS PLAN FIELD SAMPLING AND QUALITY ASSURANCE PROJECT PLAN FOR PHASE 2 EXPANDED SITE INVESTIGATION AT UNEXPLODED ORDNANCE SITE UXO 21 FORMER D AREA GAS CHAMBER MCB CAMP LEJEUNE NC

5/1/2013

CH2MHILL

Final

Sampling and Analysis Plan
Field Sampling Plan and Quality Assurance Project Plan for the Phase II Expanded Site Investigation at Site UXO-21 – Former D-Area Gas Chamber 2D MAR DIV (ASR 2.204)

Marine Corps Installations East – Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order WE54

May 2013

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

CH2MHILL

Charlotte, North Carolina

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SAP Worksheet #1—Title and Approval Page

Final
Sampling and Analysis Plan
Sampling Plan and Quality Assurance Project Plan for Phase II Expanded Site Investigation at Site UXO-21 - Former D-Area Gas Chamber 2D MAR DIV (ASR 2.204)
May 2013

Marine Corps Installations East – Marine Corps Base Camp Lejeune
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Prepared for:
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Prepared by:
CH2M HILL
11301 Carmel Commons Blvd
Charlotte, North Carolina 28226

Prepared under:
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Contract Task Order WE54

QA Review:

Daniel Hockett 5/31/13

Dan Hockett
CH2M HILL Project Manager / Date

Jessica Skeean 5/31/13

Jessica Skeean
CH2M HILL Activity Quality Manager / Date

Other Approvals:

23 May 2013

Dave Cleland
Navy Remedial Project Manager/ Date

Gena Townsend 5/23/13

Gena Townsend
USEPA Project Manager / Date

Marti Morgan 5/23/2013

Marti Morgan
NCDENR Project Manager / Date

Executive Summary

This Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP) supports the munitions response (MR) activities being performed as part of the Phase II Expanded Site Investigation (ESI) at Site Unexploded Ordnance (UXO) 21 – Former D-Area Gas Chamber 2D MAR DIV (ASR 2.204), located at Marine Corps Installations East - Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ), and serves as a guideline for the field activities and data quality assessment.

Geophysical surveys were conducted within Site UXO-21 as part of the Preliminary Assessment/ Site Inspection (PA/SI) in 2007 and 2009 (CH2M HILL, 2011), and as part of the Phase I ESI in 2011 (CH2M HILL, 2012). An intrusive investigation of the anomalies identified within the investigation area was performed. A total of 81 items of material potentially presenting an explosive hazard (MPPEH) and 3 munitions and explosives of concern (MEC) items were discovered during the PA/SI and Phase I ESI intrusive investigations. The MEC/MPPEH items found are inconsistent with activities expected at a former gas chamber and may be a result of maneuvers and military training or may be indicative of previously unidentified range activities conducted in the area.

The objective of the Site UXO-21 Phase II ESI is to characterize the nature and extent of MEC/MPPEH in the munitions response site (MRS) Adjacent to UXO-21. The Phase II ESI will involve a digital geophysical mapping (DGM) survey across 10 percent of the approximate 14-acre investigation area. Data collected during the DGM survey will be evaluated and if anomalies potentially representing MEC/MPPEH are identified, then an intrusive investigation will be performed. If MEC is identified, it will be destroyed by intentional detonation and soil samples will be collected within each detonation area to evaluate potential impacts to site media.

In order to define the extent of MEC/MPPEH beyond the northwestern, western, and southwestern boundaries of Site UXO-21, a new MRS has been established adjacent to the original UXO-21 Site boundary. The new MRS Adjacent to Site UXO-21 is shown on **Figure 2** and comprises approximately 14 acres.

This UFP-SAP is the primary work-planning document for the MR activities being performed at the MRS Adjacent to Site UXO-21. Additional documents such as the Health and Safety Plan (HSP), Technical Management Plan (TMP), Geophysical Investigation Plan (GIP), and a Geophysical Systems Verification (GSV) Plan are included as appendices to this UFP-SAP. An Explosives Safety Submission (ESS) is also being prepared for the MRS Adjacent to Site UXO-21 in support of munitions response (MR) activities in this area.

This document is being developed in accordance with the following guidance documents:

U.S. Environmental Protection Agency (USEPA) Guidance for Quality Assurance Project Plans, EPA QA/G-5, Quality Assurance Management System (USEPA, 2002).

Uniform Federal Policy for Quality Assurance Project Plans (USEPA, 2005)

This document consists of 37 worksheets, which are based upon the September 2009 MEC UFP-SAP format. All tables are embedded within the worksheets, and figures are included at the end of worksheets, where applicable.

The Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic Division, is conducting MR activities in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigation process. This UFP-SAP will be submitted to the MCIEAST-MCB CAMLEJ Environmental Restoration Partnering Team, which consists of representatives from NAVFAC Mid-Atlantic, MCIEAST-MCB CAMLEJ, USEPA Region 4, and North Carolina Department of Environment and Natural Resources (NCDENR).

This UFP-SAP will is intended to ensure that data collected or compiled are scientifically sound, of known and documented quality, and suitable for intended uses.

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SAP Worksheets

Appendices

Figures

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Abbreviations and Acronyms

AM	Activity Manager
AQM	Activity Quality Manager
ASR	archive search report
bgs	below ground surface
BIP	blow-in-place
CA	chemical agent
CAS	Chemical Abstract Service
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
CSM	conceptual site model
DFOW	definable features of work
DGM	digital geophysical mapping
DL	detection limit
DoD	Department of Defense
DQI	Data Quality Indicator
DV	Data Validation
ELAP	Environmental Laboratory Accreditation Program
ESI	Expanded Site Investigation
ESS	Explosives Safety Submission
FTL	Field Team Leader
GIP	Geophysical Investigation Plan
GPS	Global Positioning System
GSV	Geophysical System Verification (GSV)
GIS	geographic information system
H&S	Health and Safety
HEAT	high explosive anti-tank
HPLC	high performance liquid chromatography
HSP	Health and Safety Plan
IC	Ion Chromatography
ICAL	initial calibration
ICP	inductively coupled plasma
ICS	interference check sample
ICV	second source calibration verification
IDW	investigation-derived waste
LCL	lower confidence limit
LOD	limit of detection
LOQ	limit of quantitation
LCS	laboratory control sample
MC	Munitions Constituents
MCIEAST-MCB CAMLEJ	Marine Corps Installations East – Marine Corps Base Camp Lejeune
MDAS	material documented as safe

MEC	munitions and explosives of concern
MILCON	military construction
mg/kg	milligrams per kilogram
MPPEH	material potentially presenting an explosive hazard
MQO	measurement quality objectives
MR	munitions response
MRP	Munitions Response Program
MRS	munitions response site
MS	mass spectrometer
MS/MSD	matrix spike/matrix spike duplicate
NA	not applicable
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NCDENR	North Carolina Department of Environment and Natural Resources
NIRIS	Navy Installation Restoration Information Solution
NOSSA	Naval Ordnance Safety and Security Activity
NTR	Navy Technical Representative
PA	Preliminary Assessment
PAL	Project Action Limit
PETN	pentaerythritol tetranitrate
PM	Project Manager
POC	point of contact
PQL	project quantitation limit
PQO	project quality objective
PRA	Preliminary Range Assessment
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control
QSM	Quality Systems Manual
RPM	Remedial Project Manager
RRR	Recognize, Retreat, Report (or 3-R)
RSD	relative standard deviation
RSL	regional screening level
SAP	Sampling and Analysis Plan
SI	Site Inspection
SOP	standard operating procedure
SSC	Site Safety Coordinator
STC	Senior Technical Consultant
TAL	target analyte list
TBD	to be determined
TMP	Technical Management Plan (TMP)
UCL	upper confidence limit
UFP	Uniform Federal Policy
USEPA	U.S. Environmental Protection Agency
UXO	unexploded ordnance
UXOQCS	Unexploded Ordnance Quality Control Specialist
UXOSO	Unexploded Ordnance Safety Officer

SAP Worksheet #2— SAP Identifying Information

Site Name/Number: UXO-21 – Former D-Area Gas Chamber 2D MAR DIV (ASR 2.204)

Operable Unit: Not assigned

Contractor Name: CH2M HILL

Contract Number: N62470-11-D-8012, Contract Task Order WE54

Contract Title: Comprehensive Long-term Environmental Action—Navy (CLEAN) 8012

1. This QAPP was prepared in accordance with the requirements of the following documents:

U.S. Environmental Protection Agency (USEPA) Guidance for Quality Assurance Project Plans (QAPPs), EPA QA/G-5, Quality Assurance Management System (USEPA, 2002)

Uniform Federal Policy for Quality Assurance Project Plans (USEPA, 2005)

2. Identify regulatory program:

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

3. This is a project-specific QAPP for a Munitions Response (MR) investigation.

4. List dates of scoping sessions that were held:

Scoping Session*	Date
Partnering Team Scoping Session – MR Investigation Approach	September 12, 2012

List dates and titles of any Sampling and Analysis Plan (SAP) documents written for previous site work that are relevant to the current investigation.

Title	Author/Date
Site-specific Work Plan Addendum for Preliminary Assessment/Site Inspection, Site UXO-21, Former D-Area Tear Gas Chamber 2nd Marine Division, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.	*CH2M HILL, February 2010*
Site-specific Work Plan Addendum for Intrusive Investigation for Military Munitions Response Program Sites: UXO-01 – Former Live Hand Grenade Course (ASR #2.23), UXO-01 - Former Gas Chamber (ASR #2.79a, b, c), UXO-02 - Former Unnamed Explosive Contaminated Range (ASR #2.201,)UXO-07 – Former Practice Hand Grenade Course (ASR #2.77a and #2.77b),UXO-11 - Former B-5 Practice Hand Grenade Course (ASR #2.81),UXO-14 -Former Indoor Pistol Range (ASR #2.199) and Former Gas Chamber (ASR #2.200,)UXO-17 - Former Firing Position 2 (ASR #2.12), UXO-21 - Former D-Area Gas Chamber (2D MAR DIV) (ASR #2.204).	*CH2M HILL, September 2011*

5. List organizational partners (stakeholders) and connection with lead organization:

Department of the Navy (Navy) – Naval Facilities Engineering Command (NAVFAC) (lead organization)

Marine Corps Installations East – Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) (facility)

USEPA Region 4 (regulatory stakeholder)

North Carolina Department of Environment and Natural Resources (NCDENR) (regulatory stakeholder)

SAP Worksheet #2—QAPP Identifying Information (continued)

6. If any required QAPP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted QAPP elements and provide an explanation for their exclusion as follows:

   Crosswalk table is excluded, as all required information is provided in this SAP.

SAP Worksheet #3—Distribution List

Name of QAPP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address	Document Control Number
Kenneth Bowers	Navy Chemist	NAVFAC Atlantic	(757) 322-8341	Kenneth.a.bowers@navy.mil	(An administrative record number will be assigned when the final document is being prepared.)
Dave Cleland	Navy Technical Representative (NTR)	NAVFAC Mid-Atlantic	(757) 322-4851	david.t.cleland@navy.mil	
Mike Green	Munitions Response Program (MRP) Quality Assurance Officer (QAO)	NAVFAC Atlantic	(757) 322-8108	mike.green@navy.mil	
Charity Rychak	Base EMD Environmental Engineer	MCIEAST – MCB CAMLEJ	(910) 451-9385	charity.rychak@usmc.mil	
Gena Townsend	Remedial Project Manager (RPM)	USEPA	(404) 562-8538	townsend.gena@epa.gov	
Marti Morgan	NCDENR Project Manager (PM)	NCDENR	(919) 707-8342	martha.morgan@ncdenr.gov	
Matt Louth	Activity Manager (AM)	CH2M HILL	(757) 671-6240	matt.louth@CH2M.com	
Jessica Skeean	Activity Quality Manager (AQM)	CH2M HILL	(704) 543-3284	jessica.skeean@CH2M.com	
Dan Hockett	PM	CH2M HILL	(704) 543-3264	dan.hockett@CH2M.com	
Timothy Garretson	MRP Technical Lead	CH2M HILL	(904) 374-5633	timothy.garretson@CH2M.com	
Tom Roth	Senior Technical Consultant (STC)	CH2M HILL	(404) 474-7640	tom.roth@CH2M.com	
George DeMetropolis	MR Health & Safety & Quality Manager	CH2M HILL	(619) 564-9627	george.demetropolis@ch2m.com	
Tamir Klaff	Project Geophysicist	CH2M HILL	(202) 596-1199	tamir.klaff@CH2M.com	
Daniel Brown	Task Manager	CH2M HILL	(704) 544-5164	daniel.brown@ch2m.com	
To be determined (TBD)	UXO Qualified Personnel	CH2M HILL	TBD	TBD	
TBD	Field Team Leader (FTL)/Site Safety Coordinator (SSC)	CH2M HILL	TBD	TBD	
Anita Dodson	Navy Program Chemist	CH2M HILL	(757) 671-6218	anita.dodson@ch2m.com	
Clairette Campbell	Project Chemist	CH2M HILL	(757) 671-6335	clairette.campbell@ch2m.com	
Molly Nguyen	Lab PM	EMAX Labs	(310) 618-8889	mnguyen@emaxlabs.com	
Laura Maschhoff	Data Validator	DataQual Environmental Services	(314) 330-1327	dataqual@charter.net	

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SAP Worksheet #4—Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number (optional)	Signature/email Receipt	QAPP Section Reviewed	Date QAPP Read
Dave Cleland	Navy NTR	(757) 322-4851			
Charity Rychak	MCIEAST – MCB CAMLEJ/EMD Environmental Engineer	(910) 451-9385			
Matt Louth	CH2M HILL/Activity Manager	(757) 671-6240			
Jessica Skeean	CH2M HILL/Activity Quality Manager	(704) 543-3284			
Dan Hockett	CH2M HILL/PM	(704) 543-3264			
Daniel Brown	CH2M HILL/Task Manager	(704) 544-5164			
Timothy Garretson	CH2M HILL/MRP Technical Lead	(904) 374-5633			
Tamir Klaff	CH2M HILL/Project Geophysicist	(202) 596-1199			
Tom Roth	CH2M HILL/STC	(404) 474-7640			
George DeMetropolis	CH2M HILL/MR Health & Safety & Quality Manager	(619) 564-9627			
Carl Woods	CH2M HILL/Health and Safety Manager	(513) 889-5771			
Anita Dodson	CH2M HILL/Navy CLEAN Program Chemist	(757) 671-6218			
Clairette Campbell	CH2M HILL/Project Chemist	(757) 671-6335			
Molly Nguyen	EMAX Labs/ Lab PM	(310) 618-8889			
TBD	CH2M HILL/UXO Qualified Personnel	TBD			
TBD	CH2M HILL/FTL/SSC	TBD			
Geophysical Survey Subcontractor	TBD	TBD			
Unexploded Ordnance (UXO) Support Services	TBD	TBD			

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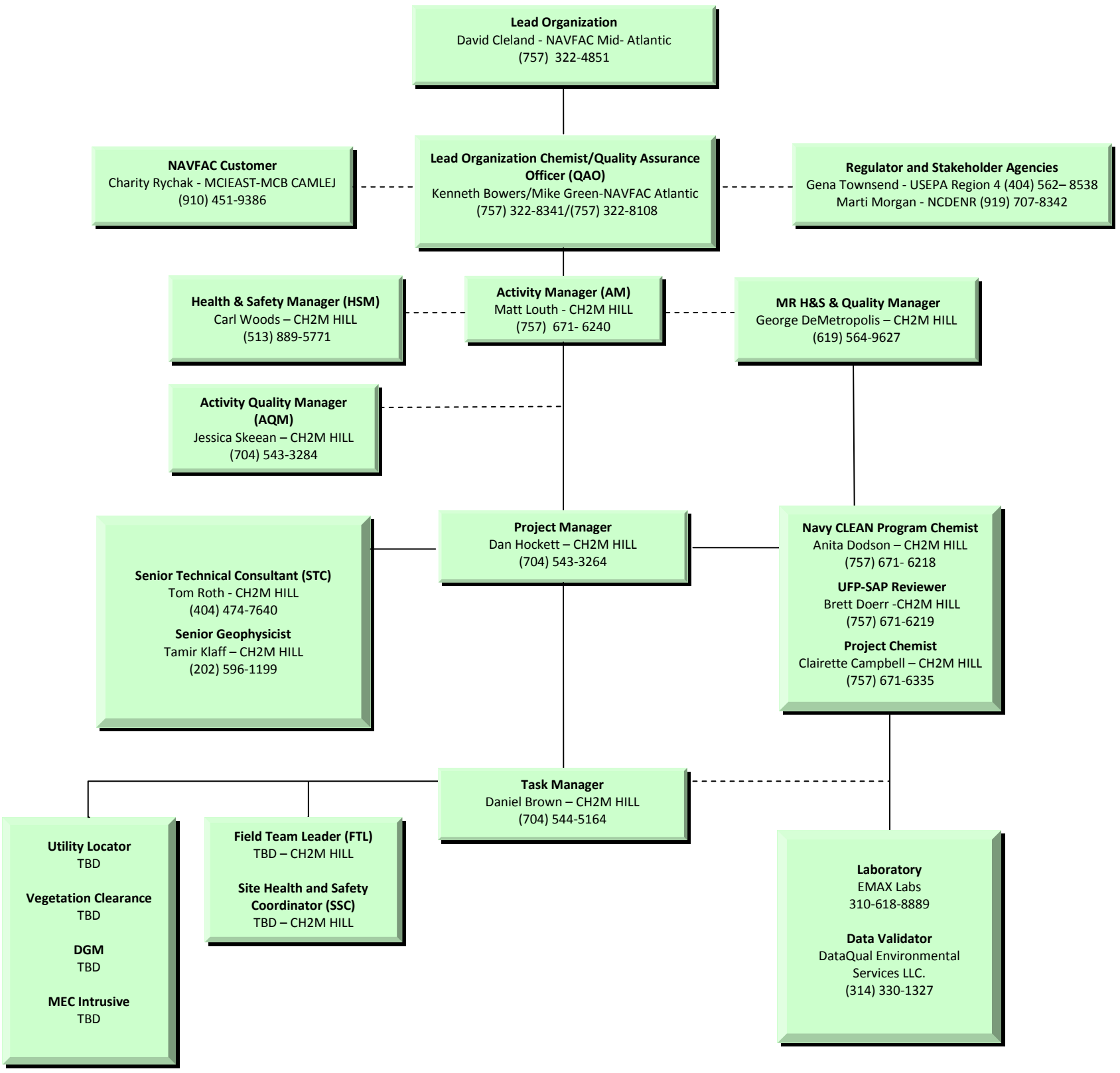
SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or E-mail	Procedure
Communication with Navy (lead agency)	Navy NTR	Dave Cleland	(757) 322-4851	Primary point of contact (POC) for Navy; can delegate communication to other internal or external POCs. RPM will notify USEPA and NCDENR via email or telephone call within 24 hours for field changes affecting the scope. Navy will have 30 days for work plan review. All sampling data will be presented and discussed during partnering meetings.
Communication with MCIEAST – MCB CAMLEJ	Base EMD	Charity Rychak	(910) 451-9385	Primary POC for the Base EMD; can delegate communication to other internal or external POCs. RPM will notify the Base EMD via e-mail or telephone call within 24 hours for field changes affecting the scope. All data results will be presented and discussed during partnering meetings
Communication with USEPA	USEPA RPM	Gena Townsend	(404) 562-8538	Primary POC for USEPA; can delegate communication to other internal or external POCs. Upon notification of field changes, USEPA will have 24 hours to approve or comment on the field changes. All data results will be presented and discussed during partnering meetings
Communication with NCDENR	NCDENR RPM	Marti Morgan	(919) 707-8342	Project POC for NCDENR; can delegate communication to other internal or external POCs. Upon notification of field changes, NCDENR will have 24 hours to approve or comment on the field changes.
Communication regarding overall project status and implementation and primary POC with Navy RPM, USEPA, and NCDENR	CH2M HILL AM	Matt Louth	(757) 671-6240	Oversees project and will be informed of project status by the PM. If field changes occur AM will work with the Navy RPM to communicate in field changes to the team via email within 24hrs. All data results will be communicated to the project team during the first partnering meeting following data receipt.
Quality issues during project implementation and data interpretation	CH2M HILL AQM	Jessica Skeean	(704) 543-3284	Contact the AQM regarding quality issues during project implementation. The AQM will report to the AM and the NAVFAC Mid-Atlantic QAO.
Technical communications for project implementation, and data interpretation	CH2M HILL STCs/Subject Matter Experts	Tom Roth Teg Williams	(404) 474-7640 (704) 543-3297	Contact senior consultant regarding questions/issues encountered in the field, input on data interpretation, as needed. Sr. Consultants will have 24 hrs to respond to technical field questions as necessary. Additionally, Sr. consultants will review of the data as necessary prior to partnering team discussion and reporting review.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or E-mail	Procedure
Communications regarding project management and implementation	CH2M HILL PM	Dan Hockett	(704) 543-3264	All information and materials about the project will be forwarded to the Navy NTR/RPM, AM, and Senior Consultants as necessary. POC for field sampling team. Responsible for field team members' and subcontractors adherence to work plan.
Health and Safety (H&S)	CH2M HILL SSC	TBD	TBD	Responsible for the adherence of team members to the site safety requirements described in the Health and Safety Plan (HSP). Will report H&S incidents and near losses to PM.
Work Plan or QAPP changes in field/ Field Progress Reports	FTL	TBD	TBD	Documentation of deviations from the Work Plan will be made in the field logbook (made with the approval of AM and/or QAO) and the PM will be notified immediately. Provide daily progress reports to PM. Deviations will be made only with approval from the PM.
Data tracking from field collection to database upload	Project Chemist	Clairette Campbell	(757) 671-6335	No analytical data can be released until validation of the data is completed and has been approved by the PC. The PC will review analytical results within 7 days of receipt for release to the project team. Tracking data from sample collection through database upload.
Field Corrective Actions	CH2M HILL FTL	TBD	TBD	The need for chemical agent (CA) for field and analytical issues will be determined by the FTL and AQM. The AQM will ensure QAPP requirements are met by field staff. The FTL will notify the PM of any needed field CAs. The PM will have 24 hours to respond to the request for field CA.
Geophysical data tracking from collection through processing	CH2M HILL Project Geophysicist	Tamir Klaff	(202) 596-1199	The Project Geophysicist will track data from collection through upload for review to ensure work plan requirements are met by geophysical survey field staff. The Geophysicist will act as the main POC for the Geophysical Survey subcontractor on all data-related issues. Data collection issues will be reported to the PM within 4 hours.
Field and Data Collection	CH2M HILL Project Geophysicist	Tamir Klaff	(202) 596-1199	Any CAs for field and data collection issues will be determined by the FTL and/or the Project Geophysicist and reported to the PM within 4 hours.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or E-mail	Procedure
Reporting Data Quality Issues	Geophysical Survey subcontractor	TBD	TBD	All quality assurance/quality control (QA/QC) issues with project data will be reported within 2 days to the PM.
Technical communications for project implementation and data interpretation	AQM and MRP Technical Lead	Jessica Skeean and Tim Garretson	(757) 322-8339 (904) 374-5633	Contact AQM and MRP technical lead regarding questions and issues encountered in the field and input on data interpretation, as needed. AQM and/or MRP technical lead will have 24 hours to respond to technical field questions as necessary. Responses will be communicated to the PM via e-mail or phone.
Reporting Lab Data Quality Issues	Laboratory PM Laboratory QAO Project Chemist	Molly Nguyen Kenette Pimentel Clairette Campbell	(310) 618-8889 (757) 671-6335	All QA/QC issues with project field samples will be reported within 2 days to the PC by the laboratory. The PC will inform the PM immediately, who in turn will inform the Navy NTR/RPM.
Reporting Data Validation Issues	Data Validation (DV) PM	Laura Maschhoff	(314) 330-1327	All data validation issues regarding resubmissions from the laboratory will be communicated to the CH2M HILL project chemist and PDM.

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SAP Worksheet #7—Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Dave Cleland	NTR	NAVFAC	Oversees project
Charity Rychak, PE	Environmental Engineer, Base EMD	MCIEAST-MCB CAMLEJ	Oversees project
Gena Townsend	USEPA RPM	USEPA	USEPA POC
Marti Morgan	NCDENR RPM	NCDENR	NCDENR POC
Matt Louth, PG	AM	CH2M HILL	Oversees project activities
Jessica Skeean, PE	AQM	CH2M HILL	Oversees project quality
Dan Hockett, PG	PM	CH2M HILL	Manages Project and coordinates project tasks and project staff
Timothy Garretson	MRP Technical Lead and Senior Technical Consultant (Munitions Response)	CH2M HILL	Provides review and approval for all MRP-related issues for the project. Provides senior MR technical support for munitions and explosives of concern (MEC).
Brett Doerr	Navy CLEAN Program UFP-SAP Reviewer	CH2M HILL	Navy CLEAN Program UFP-SAP Reviewer
Tom Roth, PE	STC, Subject Matter Expert	CH2M HILL	Provides oversight and review of all MRP-related activities. Provides senior technical support for field investigations and implementation
Tamir Klaff, PG	Project Geophysicist	CH2M HILL	Provides oversight and review of all Geophysical-Survey-related activities. Coordinates with Geophysical Survey subcontractor for data review.
Carl Woods	HSM	CH2M HILL	Prepares and manages HSP for all field activities
George DeMetropolis	CH2M HILL/MR Health & Safety & Quality Manager	CH2M HILL	Provides MR health and safety and quality guidance for all field activities
TBD	UXO Qualified Personnel	CH2M HILL	Supervises munitions-related field activities, including MEC avoidance procedures.
TBD	FTL/SSC	CH2M HILL	Provides technical oversight and support for QAPP revisions and fieldwork implementation, supervises and coordinates field activities, and oversees H&S for field activities.
TBD	Geophysical Survey Subcontractor Team	TBD	Manages geophysical data and maintains communication with CH2M HILL PM and Project Geophysicist

SAP Worksheet #7—Personnel Responsibilities and Qualifications Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibilities
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Provides UFP-SAP project delivery support, provides senior review of UPF-SAP prior to submittal to Navy, and performs data evaluation and QA oversight
Clairette Campbell	Project Chemist	CH2M HILL	Communicates with laboratory and data validator, sample tracking management, releases analytical data
Molly Nguyen	Laboratory PM	EMAX	Manages sample tracking and maintains good communication with PC
Kenette Pimentel	Laboratory QAO	EMAX	Responsible for audits, CA, checks of QA performance within the laboratory
Laura Maschhoff	Data Validator	DataQual Environmental Services, LLC	Validate data received from laboratory prior to data use

SAP Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates
Fieldwork	MEC Awareness Training[a]	CH2M HILL UXO Qualified Personnel	Prior to mobilization	FTL [to be determined (TBD], field team members (TBD), SSC (TBD), subcontractor(s)	Field team members and SSCs from CH2M HILL Field team members from subcontractor	HSP file, Project folder

[a] MEC awareness training will include Recognize, Retreat, Report (RRR or 3-R) training and an overview of the Explosives Safety Submission (ESS) requirements. The RRR training is intended to make the trainees aware of the potential presence of MEC, ways to recognize potential MEC, and what to do if potential MEC is observed. This training **DOES NOT** enable the trainee to identify the type of MEC or handle the potential MEC item. The ESS component of the training will present the requirements (e.g., procedures, separation distances, exclusion zones) to the field team.

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SAP Worksheet #9—Project Scoping Session Participants Sheet

Project Name: UXO-21 MR Investigation **Projected Date(s) of Sampling**: 2013 **PM**: Dan Hockett/CH2M HILL	**Site Name**: UXO-21 **Site Location**: MCIEAST – MCB CAMLEJ, NC
Date of Session: September 12, 2012 **Scoping Session Purpose:** Discuss the path forward for UXO-21 MR investigation.	

Name	Title/Project Role	Affiliation	Phone #	E-mail Address
Dave Cleland	RPM	NAVFAC Mid-Atlantic	(757) 322-4851	dave.t.cleland@navy.mil
Charity Rychak	RPM	EMD MCIEAST- MCB CAMLEJ	(910) 441-9385	charity.rychak@usmc.mil
Gena Townsend	RPM	USEPA	(404) 562-8358	townsend.gena@epa.gov
Marti Morgan	RPM	NCDENR	(919) 707-8342	martha.morgan@ncdenr.gov
Matt Louth	AM	CH2M HILL	(757) 671-8311	matt.louth@ch2m.com
Kim Henderson	Deputy AM	CH2M HILL	(757) 671-6258	kimberly.henderson@ch2m.com
Tom Roth	STC	CH2M HILL	(404) 474-7640	Tom.roth@ch2m.com

Comments and Decisions

The Team discussed the path forward for UXO-21. The investigation history for UXO-21 was presented, which indicated that further investigation is required for the areas surrounding the Phase I Expanded Site Investigation (ESI) area. The problem statement was defined as: Investigate nature and extent of MEC to further evaluate site boundaries.

The following investigation strategy was presented: 10% DGM and 100% intrusive investigation of the geophysical anomalies where MEC/MPPEH was discovered adjacent to the site boundary and soil sampling for MC analysis if potential releases identified and/or if a controlled detonation is conducted. Analysis will include parameters historically included in previous MR investigations on Base. The Team agreed to the MR investigation strategy presented as part of a Phase II ESI.

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SAP Worksheet #10—Conceptual Site Model

Objectives

The objective of this investigation is to evaluate the nature and extent of MEC/MPPEH in the MRS Adjacent to Site UXO-21.

This objective will be addressed by conducting a MR investigation at the MRS Adjacent to Site UXO-21. The MR investigation will consist of digital geophysical mapping (DGM) and an intrusive investigation to evaluate anomalies. DGM will be performed on approximately 10% of the 14-acre investigation area. Data collected during the geophysical survey will be evaluated and if anomalies representing potential MEC are identified, then an intrusive investigation will be performed on those anomalies. If MEC is identified, intentional detonation will be executed and soil samples will be collected to evaluate potential impacts to site media. Upon completion of the intrusive investigation, the partnering team will reconvene to determine if the nature and extent of MEC/MPPEH has been determined and if further investigation outside the current investigation area is warranted.

Site Location and Description

MCIEAST-MCB CAMLEJ covers approximately 236 square miles in Onslow County, North Carolina, and is bisected by the New River, which flows in a southeasterly direction toward the Atlantic Ocean (**Figure 1**). Construction of the Base began in 1941 and since then has been the home of "Expeditionary Forces in Readiness".

The investigation area at the MRS Adjacent to Site UXO-21 is approximately 14 acres in size and is located in the Mainside area of MCIEAST-MCB CAMLEJ, west of Sneads Ferry Road and south of Lyman Road (**Figure 2**). Sneads Ferry Road crosses from northwest to southeast through the eastern portion of the site, while an unnamed gravel road crosses from northwest to southeast through the western portion of the site.

The MRS Adjacent to Site UXO-21 is primarily composed of woodlands. The woodlands include jurisdictional wetlands and surround an unnamed tributary of Cogdels Creek, which is located approximately one-third of a mile south of the Site. Cogdels Creek, in turn, discharges into the New River downstream of the site. The topography at the Site is rolling terrain.

In March 2010, a military construction (MILCON) project began for the Gonzales Boulevard Extension Roadway. The roadway extends in a northeast-southwest orientation through the southern portion of Site UXO-21 and connects to Sneads Ferry Road. The MILCON project is ongoing. In addition, there is a proposed Financial Year 2015 MILCON project northwest of Site UXO-21 that extends into the investigation area outlined in this SAP.

Site History

CH2M HILL completed an archive search report (ASR) for Site UXO-21 as part of the Preliminary Assessment/Site Inspection (PA/SI) (CH2M HILL, 2011). A map showing the specific location of the former gas chamber was not located during the archive search, and historic maps dating between 1946 and 1984 showed no structures in the immediate area of the site. The *Preliminary Range Assessment* (USACE, 2001) and the *Closed Range List and Maps for MCB Camp Lejeune Report* (Lowder, 2005) identifies 1970 as the only period of use for this site as a gas chamber. Because this facility was used as a gas chamber, only chemical warfare training agents (tear gas) would have been used for gas mask confidence drills. However, other chemical training including war gas identification sets and riot control hand grenades may have been used in the area surrounding the gas chamber.

Adjacent and overlapping ranges may have impacted the MRS Adjacent to Site UXO-21 (**Figure 2**). These ranges include:

- Combat Area/Impact Area: This area is located east of Sneads Ferry Road as documented on Plate 2 in the *Preliminary Range Assessment* (PRA) (USACE, 2001).

SAP Worksheet #10—Conceptual Site Model (continued)

- F-6 Live Grenade Range (ASR #2.55): Documented in the PRA with eight different configurations from 1951 to 1993. The 1976 configuration extended across Piney Green Road to Site UXO-21. Potential munitions include practice and high explosive hand grenades.
- F-13 Flame Thrower Range (ASR #2.139): Documented in the PRA with four different configurations from 1954 to 1987. The 1976 configuration extended across Sneads Ferry Road to Site UXO-21.
- F-7 Flame Thrower Range (ASR #2.128): Documented in the PRA as used in 1960, this historic range is north of Site UXO-21 and does not overlap Site UXO-21.
- F-13 Field Firing Range (ASR #2.54): Documented in the PRA with four different configurations from 1951 to 1993. Does not overlap Site UXO-21. Potential munitions include mortars (81mm and 60mm) and small arms.

Previous Investigations

Environmental Investigations

Analytical results from soil, surface water, sediment, and groundwater samples collected during the PA/SI were compared to regulatory screening criteria and evaluated for potential exposure risks to human health and the environment. No unacceptable human health or ecological risks were identified from potential exposure to site media (CH2M HILL, 2011).

Geophysical Surveys and Intrusive Investigations

Geophysical survey activities were performed during the PA/SI within 100% of the accessible Phase I investigation area and within 10% of the Phase II investigation area (**Figure 3**). The portion of the Phase I investigation area that could not be accessed during the geophysical survey consisted of surface water bodies and wetland areas. The geophysical survey was performed using a single-coil EM61-MK2 high sensitivity metal detector (EM61). During the geophysical survey, a total of 1,307 geophysical anomalies representing potential subsurface MEC were identified. During the PA/SI and Phase I ESI, intrusive investigation of these anomalies was conducted. Three MEC items were discovered:

- (1) M22A1 Ground Illumination Signal (MEC)
- (1) M27A1B1 Projectile Air Burst Simulator (MEC)
- (1) Signal, Ground, Cluster, Red Star, M52A1 (MEC)

Additionally, the following MPPEH items, with corresponding quantities, were also discovered during the intrusive investigations:

- (14) Grenade, Rifle, Star, Cluster, Green, M20A1
- (2) Grenade, Hand, Practice, Standard, MKII
- (1) Projectile, 40mm, Ground Marker, Green Smoke, M715
- (2) Expended rifle grenade
- (3) Expended rifle grenade body
- (12) Tail Boom
- (1) 3.5-inch rocket motor (M28 or M29)
- (7) Signal, Ground, Green Star, Cluster, M20A1
- (1) MK II, Hand, Practice
- (3) M19 Illumination Rifle Grenade
- (1) Hand, Smoke AN-M8
- (12)Expended cartridge cases of various calibers, small arms (33 items total)
- (1) Grenade spoon

SAP Worksheet #10—Conceptual Site Model (continued)

MEC items were disposed by controlled detonation, and when required, MPPEH items were demilitarized by controlled detonations. Post-detonation surface soil samples were collected inside and outside of the detonation crater, and the results showed no contamination of the surrounding soil. Upon proper inspection and documentation, MPPEH and treated MEC were classified as MDAS and disposed by witnessed smelting.

In general, the MPPEH items discovered at Site UXO-21 are not consistent with the documented historical usage of this site as a former Gas Chamber, indicating that other unidentified munitions-related activities occurred at or in the vicinity of Site UXO-21. Overlapping and adjacent ranges, including the F-6 Live Grenade Range, Combat Area/ Impact Area, and F-13 Field Firing Range, may have impacted Site UXO-21. The discovery of grenade-related MPPEH items adjacent to Sneads Ferry Road indicates that F-6 Live Grenade Range activities may have extended to the west of Sneads Ferry road. The pyrotechnic items (flares, smoke grenades) found may be a result of maneuver/training also extending west of Sneads Ferry Road. The activities may have included the presence of an unidentified 3.5-inch rocket range, or undocumented use of 3.5-inch rockets in the Site UXO-21 area. The discovery of several MPPEH items on and near the northwestern, western, and southwestern boundaries of the site indicates that munitions-related activities may have occurred beyond the current site boundary that was defined in the PRA (USACE, 2001).

Additional DGM and intrusive investigation was recommended in the Phase I Expanded SI to define the extent of MEC/MPPEH beyond the northwestern, western, and southwestern boundaries of Site UXO-21 since MEC/MPPEH were found along the site boundary in these areas. DGM and intrusive investigation were also recommended to evaluate the nature and extent of possible MEC/MPPEH in the portion of UXO-21 that lies east of Sneads Ferry Road (which is not the subject of this UFP-SAP). No further action was recommended for the investigation of environmental contamination in site media at this time.

Current Site Investigations

A MILCON project is currently underway which includes portions of Site UXO-21, as shown on **Figure 3**. The areas identified as part of the MILCON project are undergoing 100% MEC intrusive investigations to varying depths. The Turn Lane Clearance and Utility clearance areas were completed in February 2012 to 2 feet below ground surface (bgs) and 4 feet bgs, respectively, with no MEC/MPPEH found. The Tank Trail clearance area was completed in June 2012 to 4 feet bgs and a M27A1B1 Projectile Air Burst Simulator (MEC) and 8 MPPEH items were discovered

A DGM and intrusive investigation adjacent to Sneads Ferry Road is being conducted as part of the road widening MILCON project (**Figure 3**). The clearance to 4 ft bgs on the east and west side of Sneads Ferry Road as part of the road widening is ongoing and to date, the following MPPEH items, with corresponding quantities, were discovered during the intrusive investigations:

- (1) Bomb, Practice, M23
- (5) Grenade, Rifle, Signal, M11
- (1) Grenade, Rifle, high explosive anti-tank (HEAT), M9
- (40) Expended cartridge cases of various calibers, small arms

Because DGM and intrusive investigations are being conducted in the portion of UXO-21 east of Sneads Ferry Road as part of the MILCON project, no additional DGM or intrusive investigations will be conducted in this area as part of this Phase II ESI. **Figure 4** shows each phase of investigation and MILCON support as well as the locations of all MEC and MPPEH found at Site UXO-21 to date.

SAP Worksheet #10—Conceptual Site Model (continued)

Site Geology

Given the relatively shallow depths of intrusive investigation activities, this discussion of site-specific geology is limited to the Undifferentiated Formation that overlies the Belgrade and River Bend Formations. Inspection of the soil cores recovered from Site UXO-21 indicates that the underlying sediments consist of fine to medium-grained sands with varying amounts of silt and clay consistent with those of the surficial aquifer (Cardinell, Berg, and Lloyd, 1993). Particle sizes noted from soil boring logs indicate sediments ranging from clay and silt to cobble size stones. The predominant lithology directly underlying Site UXO-21 consists of poorly graded, silty sand interbedded with a lesser amount of clayey and gravelly sands (CH2M HILL, 2011).

Hydrogeology

Site-specific hydrogeologic information was derived from the installation of ten shallow temporary monitoring wells in 2010. The monitoring wells were screened above the Castle Hayne confining unit in the undifferentiated surficial aquifer. Groundwater elevations ranged from 3.38 to 18.80 feet above mean sea level. **Figure 5** depicts the potentiometric surface on April 10, 2010 and indicates that groundwater mimics surface topography and generally flows to the west-southwest. Horizontal hydraulic gradients observed at the site ranged from 0.008 feet per foot (ft/ft) to 0.012 ft/ft.

Surface Water Hydrology

Surface water drainage at the MRS Adjacent to Site UXO-21 flows into an unnamed tributary of Cogdels Creek that crosses the site and flows to the west-southwest toward the New River. Jurisdictional wetlands are also present onsite and cover approximately 5 percent of the site (**Figure 2**).

Ecological Setting

The investigation area is predominantly undisturbed forested land west of Sneads Ferry Road. Areas of wetlands are located in the southern, western, and northern portions of the site. This site is more than 1 mile east of the New River and 0.3 mile north of Cogdels Creek. Groundwater flow in the area is to the southwest. In the UXO-21 Phase I and Phase II investigation areas of the PA/SI, constituents detected in surface soil, groundwater, surface water, and sediment presented no significant risks to populations of ecological receptors (CH2M HILL, 2011).

Conceptual Site Model

In general, the conceptual site model (CSM) relates potentially exposed receptor populations with potential source areas based upon physical site characteristics and complete exposure pathways. Important components of the CSM are the identification of potential source areas, transport pathways, exposure types, exposure pathways and routes, and receptor groups.

There are two types of exposure that could potentially exist at the site: (1) munitions constituents (MC) exposure from post detonation activities and (2) MEC exposure. The results of the PA/SI concluded that there are no unacceptable human health or ecological risks from exposure to surface and subsurface soil, groundwater, surface water and sediment, as a result of MC exposure (CH2M HILL, 2011); however, human and ecological receptors may be exposed to post-detonation contamination of surface soil, if detonation activities are performed. Surface and subsurface MEC have the potential to be an explosive hazard at the MRS Adjacent to Site UXO-21. Their exposure point would remain at the original depositional location of the MEC, either on the surface in vegetated areas or in the shallow subsurface.

SAP Worksheet #10—Conceptual Site Model (continued)

Actual or potential exposures of human health and ecological receptors associated with a site are determined by identifying the most likely, and most important, pathways of contaminant release and transport. A complete exposure pathway has three components:

- A source of chemicals that results in a release to the environment
- A pathway of chemical transport through an environmental medium
- An exposure or contact point for a human health and/or ecological receptor.

Potential Source Areas

The primary source of MEC contamination at this site is unknown since the historical usage of the site is former gas chamber, indicating that other unidentified munitions-related activities occurred at or in the vicinity of the Site and may be from base maneuvering/training activities.

Release Mechanisms and Transport/Exposure Pathways

A transport pathway describes the mechanisms whereby site-related constituents, once released, may be transported from a source area to exposure media (surface soil) where receptor exposures may occur. An exposure pathway describes the mechanisms whereby receptors come into contact with post-detonation MC. Exposure, and thus potential risk, can only occur if complete exposure pathways exist.

MEC Exposure

A MEC exposure pathway requires both access and interaction. The receptor must not only have access to an area that contains MEC, but the receptor's activities must be such that there is interaction with the MEC item. The investigation area is mostly undeveloped but does contain a new constructed tank trail and is transected by a gravel road and the newly constructed Gonzalez Boulevard. The investigation area is accessible to anyone with Base access. Thus, potential receptors at this site include authorized persons and trespassers and ecological receptors that may be present.

Interaction with MEC items may include handling/treading underfoot for MEC items located on the surface and intrusive actions for subsurface MEC.

Post-Detonation MC Exposure

Human and ecological receptors may be exposed to post-detonation MC through contact with surface soil, if detonation activities are performed. If detonation activities are performed, surface soil samples will be collected at the detonation site and will be screened for human health and ecological risks, according to the Post-Detonation Data Evaluation Process presented in **Figure 6**. If post-detonation MC contamination is found in the surface soil within the detonation site during the Phase II ESI field effort, the surface soil will be removed as IDW.

Human Health Exposures and Receptors

Access to the MRS Adjacent to Site UXO-21 is restricted to military personnel and civilians authorized to enter the Base. There is the potential for site workers, military personnel, and site visitors/trespassers to be exposed to MEC/MPPEH. Physical contact with MEC/MPPEH may result in unintentional detonation of the item, resulting in explosive safety risks.

There are no potential receptors for MC released during post-detonation activities since the surface soil will be removed as IDW if MC contamination is found in the surface soil at the detonation site.

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SAP Worksheet #11—Project Quality Objectives (PQOs) and Systematic Planning Process Statements

Problem Definition

Based on previous investigations and MILCON support, the nature and extent of MEC/MPPEH beyond the northwestern, western, and southwestern boundaries of Site UXO-21 is unknown.

The following questions will be answered by the Phase II MR investigation at Site UXO-21:

1. **What is the nature and extent of MEC at UXO-21?**

   DGM will be conducted along transects that comprise approximately 10% coverage of the additional MRS (approximately 1.4 acres). The total length of the DGM transects across the estimated 1.4 acres is approximately 18,587 linear feet (5,665 linear meters). A MEC/MMPEH intrusive investigation will be performed on 100 percent of geophysical anomalies identified as potential MEC/MMPEH. The intrusive investigation will be performed up to 2 feet bgs based on historical use of the site. See **Appendix A** for detailed information regarding the MEC intrusive investigation.

   Upon completion of the intrusive investigation, the partnering team will reconvene to determine if the nature and extent of MEC/MPPEH has been determined and if further investigation outside the current investigation area is warranted. The results of the investigation will be presented in a Phase II ESI Report.

2. **If intentional detonations are conducted during the course of the intrusive investigation, have munitions contaminants been released to surface soil?**

   If MEC/MPPEH is identified and detonated onsite, surface soil samples will be collected at locations where controlled detonations/ blow-in-place (BIP) are conducted. Two post-detonation composite soil samples will be collected at each location where intentional detonation or BIP has been performed as described in the **Technical Management Plan (TMP)** (**Appendix A**). Soil samples will be analyzed for explosives residues (including pentaerythritol tetranitrate [PETN] and nitroglycerine), perchlorate, Target Analyte List (TAL) metals, and hexavalent chromium.

3. **If post-detonation contaminants are identified, what is the appropriate next step?**

   This determination will be made according to the Post-Detonation Data Evaluation Process presented in **Figure 6**.

4. **If MEC/MPPEH are found at the boundary of the investigation area, how will the nature and extent of MEC/MMPEH be determined?**

   The nature and extent of MEC/MPPEH will be determined based on the type, density, and location of the MEC/MPPEH items discovered, if any. Upon completion of the intrusive investigation, the partnering team will reconvene to determine if the nature and extent of MEC/MPPEH has been determined and if further investigation outside the current investigation area is warranted.

Who will use the data?

The data will be used by the Navy, USEPA, and NCDENR to determine whether additional investigation may be required to evaluate the hazards associated with the site. Data from post-detonation sampling, if controlled detonations are necessary, will be used to determine whether soil at controlled detonation areas will require disposal as investigation-derived waste (IDW).

If geophysical anomalies representing potential MEC are identified during the geophysical survey, DGM data will be used by the intrusive investigation team to reaquire and intrusively investigate those anomalies. The intrusive team will excavate anomaly sources up to 2 feet to evaluate the nature and extent of MEC/MPPEH, and demilitarize MEC/MPPEH, if necessary.

SAP Worksheet #11—Project Quality Objectives (PQOs) and Systematic Planning Process Statements (continued)

What are the Project Action Limits (PALs)?

PALs will be used during this investigation to determine whether soil at controlled detonation areas will require disposal as IDW (see Post-Detonation Data Evaluation Process in **Figure 6**). The PALs were developed by the project team and are the lower of the Ecological Screening Value, NCSSLs, and Residential RSLs Adjusted, and will be evaluated as summarized below:

- Surface soil analytical results will be evaluated based on the Post-Detonation Data Evaluation Process provided as **Figure 6**.

For what will the data be used?

Data collected during this MR investigation will be used to evaluate the nature and extent of MEC/MPPEH to assist with future decision making processes with regards to MRS Adjacent to Site UXO-21. Specific data uses are outlined in **Figure 6** and detailed below.

DGM data collected will be used to:

Identify geophysical anomalies
Assist in planning the MEC intrusive investigation

Data collected during the intrusive investigation will be used to:

Determine the nature and extent of MEC/MPPEH
Evaluate whether no further action is warranted.

If controlled detonation/BIP is performed, surface soil data will be used to:

Conduct a human health and ecological risk screening (and assessment, if warranted)
Determine if soil affected by controlled detonation/BIP needs to be removed as IDW

What types of data are needed?

Generally, DGM data are needed to meet the objective of characterizing the nature and extent of MEC. Secondarily, if a controlled detonation is required, laboratory analytical data from surface soil samples will also be needed for risk screening. Refer to **Worksheet #10** (Problem Definition) and the **Geophysical Investigation Plan (GIP)** (**Appendix B**) for further information.

How "good" does the data need to be?

- The objective of the DGM is to identify geophysical anomalies indicative of potential MEC/MPPEH; as a result, measurement quality objectives (MQOs) for DGM have been developed. The MQO for DGM system positioning is that the positional data are of sufficient accuracy to facilitate reacquisition of anomalies representing potential MEC/MPPEH for subsequent investigations. Measurement Performance Criteria are provided in **Worksheet #12** and are described in detail in the **GIP (Appendix B)**.
- The specific QC audit procedures for the definable features of work (DFOWs) to be employed, including the phase during which it is performed, the frequency of performance, the pass/fail criteria, and actions to take if failure occurs, are presented in the **GIP (Appendix B)**.
- The laboratory data will be of the quantity and quality necessary to provide technically sound and defensible assessments of the conditions at each post-detonation location. Laboratory data will be distributed to a third party validator (DataQual) for data validation. Field and laboratory QC data requirements are detailed in **Worksheets #12** and **#28**, respectively.

SAP Worksheet #11—Project Quality Objectives (PQOs) and Systematic Planning Process Statements (continued)

- The laboratory data will be reported in Level 4 data packages. Level 4 data packages, as applicable per method, will include raw data chromatograms, initial and continuing calibration information, surrogate recovery information, internal standard information, method blank information, laboratory control sample (LCS)/sample duplicate information, matrix spike/matrix spike duplicate (MS/MSD) information, instrument tuning summary, post-digestion spike information, serial dilution information, inter-element correction factor information, and degradation information. Department of Defense (DoD) Quality Systems Manual (QSM) version 4.2 is being adopted for this project work and will be used to assess precision and accuracy.

How much data should be collected?

DGM will be performed across 10 percent of the accessible areas of the investigation area as indicated on **Figure 7**. An intrusive investigation will be performed on geophysical anomalies representing potential subsurface MEC as described in **Section 4** of the **TMP** (**Appendix A**). If MEC/MPPEH disposal is performed (via controlled detonation), a minimum of 2 surface soil samples will be collected per detonation location.

Where, when, and how should the data be collected and generated?

DGM will be performed across 10 percent of the accessible areas of the site as indicated on **Figure 7**, using a Geonics EM61-MK2. The EM61-MK2 data will be used to identify geophysical anomalies representing potential subsurface MEC. If review of DGM data identifies anomalies as representing potential subsurface MEC, these anomalies will be investigated by intrusive activities to confirm if MEC is present.

The schedule of activities is presented in **Worksheet #16**.

Data will be collected and generated in accordance with the procedures outlined in this QAPP. Specifically, see the TMP **(Appendix A)** the SOPs in **Appendix D** for more details.

Who will collect and generate the data? How will the data be reported?

DGM data will be collected and reported by geophysical subcontractor (to be determined) as detailed in the **GIP** (**Appendix B**).

The MPPEH/MEC intrusive investigation will be conducted by qualified UXO subcontractors supervised by CH2M Hill UXO personnel in accordance with **Section 4** of the **TMP** (**Appendix A**).

CH2M HILL will collect post-detonation surface soil samples, if necessary, in accordance with **Section 3** of the **TMP** (**Appendix A**).

- Laboratory analytical services will be provided by EMAX Laboratories, a DoD Environmental Laboratory Accreditation Program accredited analytical laboratory under subcontract to CH2M HILL.
- Once generated, analytical data will be validated against analytical methodology requirements and measurement performance criteria presented in this UFP-SAP.
- CH2M HILL will receive validated data and upload the data into a centralized electronic database used for Navy projects.
- CH2M HILL will prepare a Phase II ESI report, as described in Worksheet 17

How will the data be archived?

Data will be archived according to the Navy CLEAN program/contract requirements. Data will be submitted to the Navy for uploading into Naval Installation Restoration Information Solution (NIRIS) and the Administrative Record. At the end of the project, compact discs containing the archived laboratory data and validation reports will be provided to the Navy.

SAP Worksheet #11—Project Quality Objectives (PQOs) and Systematic Planning Process Statements (continued)

PQOs listed in the form of if/then qualitative and quantitative statements.

The post-detonation data evaluation process depicted on **Figure 6** represents the PQOs for post detonation sampling data evaluation, if warranted. Specific "quantitative" PQOs are not currently developed. Data from this investigation may be used during future project activities to further develop PQOs for any additional investigations or activities. General "qualitative" PQOs are provided as follows, in the form of if/then statements, to summarize the objectives of this investigation.

If no geophysical anomalies are identified as representing potential subsurface MEC, then no further action will be required for this 14-acre MRS.

If geophysical data collected indicate the presence of geophysical anomalies representing potential subsurface MEC, then an intrusive investigation will be conducted.

If intrusive activity extends to a maximum depth of up to 2 feet bgs and anomaly sources representing potential MEC have not been identified, those locations will either be reinvestigated, or a comment will be entered along with the investigation results indicating the suspected reason.

If the anomaly investigation identifies MEC, the item will be demilitarized through onsite controlled detonation in accordance with Section 6.4 of the ESS. The location of the MEC item will be recorded using a handheld GPS so the coordinate data can be entered into the NIRIS database for reporting purposes.

If the anomaly investigation identifies MPPEH, the item will be placed in a temporary accumulation point and managed in accordance with the Section 6.4 of the ESS. MPPEH will be visually inspected and independently reinspected for explosive hazards. MPPEH that cannot be classified as material documented as safe (MDAS) will be disposed of in the same manner as MEC. MDAS will be transported offsite. The location of MPPEH will be recorded using a handheld Global Positioning System (GPS) so the coordinate data can be entered into the NIRIS database for reporting purposes. If the item is cultural debris or other debris, it will be collected and segregated away from MPPEH as described in the **TMP** (**Appendix A)**.

SAP Worksheet #12-1—Measurement Performance Criteria Table (MR)

Definable Feature of Work Data Type	Geophysical Anomaly Measurement Data Quality Indicator (DQI)	QC Sample and/or Activity to Assess Measurement Performance	Measurement Performance Criteria	Frequency
DGM Systems Munitions Detection (EM61-MK2)	Sensitivity	Measure response to industry standard object with stationary system and object at fixed height and position relative to sensor.	Response will be ± 20 percent of published response for given orientation and height of object relative to system	At the beginning and end of each work day, as well as in between individual survey units (such as grid or block of grids).
DGM Data Positioning	Accuracy	Measurement of seeded instrument verification strip (IVS) and blind seeding program for production survey	Location of seeds in IVS will be ±25 centimeters from known, surveyed locations; blind seeds will be located within 1 meter of known, surveyed locations.	IVS measurements will be made daily; blind seeds will be encountered at least one per day during production survey
DGM Data Density	Accuracy	Results of daily DGM data will be evaluated during QC review by QC Geophysicist for compliance	Greater than 98 percent of possible sensor readings are captured along each survey lane with spacing no greater than .213 meter. Data gaps greater than 0.61 meter will not be compliant.	Daily
DGM Survey Coverage	Accuracy	Results of daily DGM data will be evaluated during QC review by QC Geophysicist for compliance	Land spacing across survey area will not be greater than 1 m, with an intended lane spacing of 0.75 m. Exceptions would include obstructions at surface	Daily
DGM Data Repeatability	Repeatability, Sensitivity, and Accuracy	Measure response to ISO with stationary system and object at fixed height and position relative to sensor; also includes collection of repeat data line	Response will be ± 20 percent of published response for given orientation and height of object relative to system. Repeat line will be qualitatively compared to results of initial survey data.	At the beginning and end of each work day, as well as in between individual survey units (such as grid or block of grids). Repeat data line will be collected per individual survey unit.
Removal Verification	Accuracy	Resurvey the anomaly source excavation using a Geonics EM61-MK2 time-domain metal detector.	Response will be less than established target selection threshold. If location cannot be cleared to this threshold, conditions at hole will be documented and explanation provided.	Following excavation of each anomaly source.
QC Seed Recovery	Accuracy	Recover 100% of QC seed items.	100% of QC seed items recovered.	During the intrusive investigation.

SAP Worksheet #12-2—Definable Features of Work Auditing Procedure

Definable Feature of Work	Task with Auditable Function	Audit Procedure	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Pre-mobilization Activities	Geographic information system (GIS) Setup	Verify GIS system is functional and ready for site data	PP*	Once	GIS system has been set up and is ready for site data	Do not proceed with field activities until criterion is passed
	Document Management and Control	Verify appropriate measures are in place to manage and control project documents	PP	Once	Appropriate measures are in place to manage and control project documents	Do not proceed with field activities until criterion is passed
	Data Management	Verify appropriate measures are in place to manage and control project data	PP	Once	Appropriate measures are in place to manage and control project data	Do not proceed with field activities until criterion is passed
	Subcontractor Procurement	Ensure procurement of subcontractors and verify qualifications, training, and licenses	PP/IP**	Once	Subcontractors' qualifications, training, and licenses are up to date and acceptable	Ensure subcontractor provides qualifications, training, and licenses or change subcontractor
	ESS	Verify the ESS has been developed and approved	PP/IP	Once	ESS has been approved	Do not proceed with field activities until criterion is passed
	Work Plan	Verify the Project Work Plan has been developed and approved	PP/IP	Once	Work plan has been prepared and approved, all parties agree to the technical and operational approach	Do not proceed with field activities until criterion is passed

SAP Worksheet #12-2—Definable Features of Work Auditing Procedure (continued)

Definable Feature of Work	Task with Auditable Function	Audit Procedure	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Mobilization/ Site Preparation	Onsite Document Review	Verify Project Plans are approved, reviewed with project team, and have acquired appropriate signatures	PP/IP	Once	Document is approved and has been reviewed and acknowledged by appropriate project team members	Personnel who are not familiar with the Project Plans may not proceed with field activities until criteria are passed
	Establish Communication and Logistics	Verify coordination and functionality of communications equipment and logistical support	PP/IP	Once per site	Communications and other logistical support are coordinated	Do not proceed with field activities until criteria are passed
	Verify site-specific training	Verify all site-specific training has been performed and acknowledged	PP/IP	Once for each team member	Site-specific training is performed and acknowledged	Do not proceed with field activities until criteria are passed
	Site Boundary and Grid Establishment	Verify area/boundary and grids	PP/IP	Once per site	Area/boundary is correct and grids are appropriate	Stop activities until area/boundary/grid approach is verified

SAP Worksheet #12-2—Definable Features of Work Auditing Procedure (continued)

Definable Feature of Work	Task with Auditable Function	Audit Procedure	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Geophysical Survey	Equipment Testing	Verify equipment testing has been performed and equipment is functional	IP/FP***	Once/Daily/As Required	Equipment passed functionality test as required by this QAPP	Repair or replace instrument
	Work Methods	Verify work methods are established and have been communicated to each team member	IP/FP	Daily	Work methods are established and communicated and are being performed in accordance with this QAPP and SOPs	Stop activities until the QAPP and SOPs can be followed and any activities not performed within compliance are re-evaluated and re-performed, if necessary
	Geophysical Survey	Verify survey of the area is performed as detailed in this QAPP	IP/FP	Daily	Geophysical activities are being performed in accordance with this QAPP and SOPs	Stop work until activities are corrected and in compliance with the QAPP and the SOPs
	Data Transfer/Upload to FTP	Verify data are transferred for review	IP/FP	Per Data Collection Set	Data have been transferred as required by this QAPP and SOPs	Request transfer of data
Geophysical Data Evaluation	Geophysical Data Processing and Interpretation	Verify data processing is adequately performed and interpretation/ anomaly selection is appropriate	IP/FP	Per Data Package	Data are appropriately processed and interpreted and anomaly selection has been made as detailed in this QAPP	Request resubmitted or recollection of data, as necessary, for adequate review

SAP Worksheet #12-2—Definable Features of Work Auditing Procedure (continued)

Definable Feature of Work	Task with Auditable Function	Audit Procedure	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Intrusive Investigation	Equipment Testing	Verify equipment and personnel operating in accordance with MEC SOP	IP/FP	Daily/Each Occurrence	Equipment passed functionality test as required by this QAPP	Repair or replace instrument
	Work Methods	Verify separation distance is as established	IP/FP	Daily	Team separation distance if appropriate for work being performed	Stop activities until the appropriate separation distance is achieved
	Anomaly Recovery	Verify the item recovered is appropriate to amplitude of initial anomaly detected	IP/FP	Daily	Recovered item is appropriate to the amplitude of the initial anomaly detected during DGM	Return to item location to determine if additional anomalies are present. Perform root-cause analysis if the item recovered is inappropriate for the amplitude detected during DGM
	QC Seed Recovery	Verify QC seeds are recovered	IP/FP	Each Occurrence	All QC seed items in area of operation recovered.	A root-cause analysis must be performed and the project team must meet to discuss and determine appropriate action.
	QC Checks	Verify operations are conducted in accordance with QAPP, MEC Removal SOPs, and the HSP: -surveys/sweeps -MEC surface sweeps -Analog detection and removal actions -DGM anomaly investigation -Ammunition and explosives transportation -Explosives storage and accountability -Disposal/demolition operations -Scrap inspection operations	IP/FP	Daily	Work performed in accordance with QAPP, referenced MEC SOPs, and the HSP.	Stop activity until full compliance can be assured and any activities not performed within compliance are re-evaluated and re-performed if necessary.

SAP Worksheet #12-2—Definable Features of Work Auditing Procedure (continued)

Definable Feature of Work	Task with Auditable Function	Audit Procedure	QC Phase	Frequency of Audit	Pass/Fail Criteria	Action if Failure Occurs
Intrusive Investigation	MPPEH/ munitions debris (MD) Management	Verify inspection/certification/disposal is conducted per QAPP	IP/FP	Daily	Work performed in accordance with QAPP, SOPs, and HSP	Stop work until activities are corrected and in compliance with the QAPP and the SOPs
Demobilization	Demobilize from the site	Verify equipment and personnel have been demobilized from the site and the site is returned to pre-mobilization condition	FP	Once	All personnel and equipment have been demobilized and the site is in pre-construction condition	Restore site to preconstruction condition, package and ship all equipment offsite, and demobilize crew

*PP Preparatory Phase
**IP Initial Phase
***FP Follow-up Phase

SAP Worksheet #12-3A—Measurement Performance Criteria Table – Field QC Samples

Matrix: Composite Soil

Analytical Group: Explosives and Perchlorate

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Explosives (including PETN, Nitroglycerin, and Perchlorate)	One per 10 field samples	Precision	Relative Percent Difference (RPD) ≤30%	S & A
Equipment Rinsate Blank		One per day when using decontaminated equipment	Bias / Contamination	Same as Method Blank, refer to ***Worksheet 28-1*** and ***Worksheet 28-2*** (for Perchlorate)	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

SAP Worksheet #12-3B—Measurement Performance Criteria Table – Field QC Samples

Matrix: Composite Soil
Analytical Group: Metals and Chromium VI

QC Sample	Analytical Group	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Metals (including Mercury and Chromium VI)	One per 10 field samples	Precision	Relative Percent Difference (RPD) ≤30%	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Method Blank, refer to ***Worksheet 28-3***, ***Worksheet 28-4*** *(for Mercury),* and ***Worksheet 28-5*** (for Chromium VI)	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

SAP Worksheet #13—Secondary Data Criteria and Limitations Table

Secondary Data	Data Source	Data Generator(s), data types (dates)	How Data Will Be Used	Limitations on Data Use
Locations and types of MEC found	CH2M HILL, 2011. Preliminary Assessment/Site Investigation Report *MMRP Site UXO-21 (ASR#2.204), Former D-Area Gas Chamber (2D MAR DIV)*, MCIEAST – MCB CAMLEJ	CH2M HILL, groundwater (2007, and 2010), soil (2007 and 2010), surface water and sediment (2010)	Report lists MEC and MPPEH items that were discovered	MEC list may not be inclusive of all potential MEC at UXO-21
	CH2M HILL, 2012. Expanded Site Investigation Report, *MMRP Site UXO-21 (ASR#2.204, Former D-Area Gas Chamber (2D MAR DIV)*, MCIEAST – MCB CAMLEJ	CH2M HILL, intrusive investigation (2010)	Report lists MEC and MPPEH items that were discovered.	MEC list may not be inclusive of all potential MEC at UXO-21

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SAP Worksheet #14—Summary of Project Tasks

Activities to be performed at this site have been divided into DFOWs as well as the tasks to be completed for each of these definable features. Procedures for these tasks, including QC checks, recording and correcting data, data processing, data management, and information management, will be performed in accordance with the TMP (**Appendix A**) and Standard Operating Procedures (SOPs) (**Appendix D**) of this QAPP.

Definable Feature of Work	Tasks
Pre-mobilization Activities	UFP-SAP and ESS Development and Approval GIS Setup Document Management and Control Data Management Subcontractor Procurement
Mobilization and Site Preparation	Mobilize Crew and Equipment Onsite Document Review Communications and Logistics Establishment Site Specific Training DGM Boundary and Grid Establishment Clear Vegetation QC Seed Emplacement
Geophysical Investigation	Equipment Testing Review of Work Methods Geophysical Survey (EM61-MK2) Data Transfer/Upload to FTP
Data Evaluation	QC Review of Field Data Pre-processing of Data Geophysical Data Processing and Interpretation QC of Final Data
MEC Intrusive Investigation	Re-acquire anomalies identified during DGM Excavate Anomaly Sources Destroy by detonation MEC items at the site Removal Verification Verification of QC Seed Recovery Confirm that 100 percent of selected geophysical anomalies have been re-acquired and investigated Confirm that all MPPEH has been documented as material documented as safe (MDAS) with all required documentation. MDAS will be transported offsite for thermal destruction.
Demobilization	Demobilize Crew and Equipment
Final Report and Closeout	Data Compiling and Reporting Report Preparation Data Archiving Procurement Closeout

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SAP Worksheet #15-1—Reference Limits and Evaluation Table

Matrix: Composite Soil

Analytical Group: Explosives, including Nitroglycerin, PETN, and Perchlorate

Analyte	CAS Number	Ecological Screening Value (April 2012)[1,2] (mg/kg)	NCSSLs (Feb 2012)[1,2] (mg/kg)	Residential RSLs Adjusted (May 2012)[1,2] (mg/kg)	Project Quantitation Limit Goal[2,3] (mg/kg)	Laboratory-specific (mg/kg)			LCS and MS/MSD Recovery Limits and RPD(%)[4]		
						LOQ	LOD	DL	LCL	UCL	RPD
1,3,5-Trinitrobenzene	99-35-4	NC	NC	220	110	0.4	0.1	0.05	75	125	30
1,3-Dinitrobenzene	99-65-0	NC	NC	0.61	0.305	0.4	0.1	0.05	80	125	
2,4,6-Trinitrotoluene	118-96-7	NC	NC	3.6	1.8	0.4	0.1	0.05	55	140	
2,4-Dinitrotoluene	121-14-2	NC	0.0016	1.6	0.0008	0.4	0.1	0.055	80	125	
2,6-Dinitrotoluene	606-20-2	NC	NC	6.1	3.05	0.4	0.1	0.056	80	120	
2-Amino-4,6-dinitrotoluene	35572-78-2	NC	NC	15	7.5	0.4	0.1	0.05	80	125	
2-Nitrotoluene	88-72-2	NC	NC	2.9	1.45	0.4	0.1	0.076	80	125	
3-Nitrotoluene	99-08-1	NC	NC	0.61	0.305	0.4	0.1	0.095	75	120	
4-Amino-2,6-dinitrotoluene	19406-51-0	NC	NC	15	7.5	0.4	0.1	0.05	80	125	
4-Nitrotoluene	99-99-0	NC	NC	24	12	0.4	0.1	0.099	75	125	
HMX	2691-41-0	NC	NC	380	190	0.4	0.1	0.05	75	125	
Nitrobenzene	98-95-3	40	NC	4.8	2.4	0.4	0.1	0.05	75	125	
Nitroglycerin	55-63-0	NC	NC	0.61	0.305	1	0.25	0.125	**50**	**150**	
Pentaerythritol tetranitrate (PETN)	78-11-5	NC	NC	12	6	1	0.25	0.125	**50**	**150**	
RDX	121-82-4	NC	NC	5.6	2.8	0.4	0.1	0.05	70	135	
Tetryl	479-45-8	NC	NC	24	12	0.4	0.1	0.057	10	150	
Perchlorate	14797-73-0	NC	NC	5.5	2.75	0.004	0.001	0.0005	**80**	**120**	**15**

NC: No screening level for this compound.

[1]The Project Action Limit (PAL) is the lower of the Ecological Screening Value, NCSSLs, and Residential RSLs Adjusted.

[2] PALs and Project QL Goals assume dry weight basis.

[3] The Project Quantitation Limit (PQL) Goal is 1/2 the PAL.

[4] DoD QSM v.4.2 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

Shading represents instances where the PAL is lower than the LOD. Non-detects will not be treated as exceedances though they will be reported at a value greater than the PQL Goal.

SAP Worksheet #15-2—Reference Limits and Evaluation Table

Matrix: Composite Soil
Analytical Group: Metals and Chromium VI

Analyte	CAS Number	Ecological Screening Value (April 2012)[1,2] (mg/kg)	NCSSLs (Feb 2012)[1,2] (mg/kg)	Residential RSLs Adjusted (May 2012)[1,2] (mg/kg)	Background Undeveloped SS Combined Soil Type[1,2] (mg/kg)	Project Quantitation Limit Goal[2,3] (mg/kg)	Laboratory-specific (mg/kg)			LCS and MS/MSD Recovery Limits and RPD(%)[4]		
							LOQ	LOD	DL	LCL	UCL	RPD
Aluminum	7429-90-5	50	NC	7700	12800	6400	100	10	5	80	120	30
Antimony	7440-36-0	0.27	0.9	3.1	1.87	0.935	0.5	0.20	0.10			
Arsenic	7440-38-2	18	5.8	0.39	1.17	0.585	0.5	0.10	0.05			
Barium	7440-39-3	330	580	1500	36.7	18.35	0.5	0.10	0.07			
Beryllium	7440-41-7	21	63	16	0.195	0.0975	0.5	0.10	0.05			
Cadmium	7440-43-9	0.36	3	7	0.2	0.1	0.5	0.10	0.06			
Calcium	7440-70-2	NC	NC	NC	8470	4235	100	20.00	17.00			
Chromium	7440-47-3	26	3.8	0.29	17.4	8.7	0.5	0.10	0.05			
Cobalt	7440-48-4	13	0.9	2.3	0.414	0.207	0.5	0.10	0.05			
Copper	7440-50-8	28	700	310	17.1	8.55	0.5	0.20	0.10			
Iron	7439-89-6	200	150	5500	7210	3605	100	10.00	5.00			
Lead	7439-92-1	11	270	400	27.5	13.75	0.5	0.10	0.05			
Magnesium	7439-95-4	NC	NC	NC	904	452	100	20.00	10.00			
Manganese	7439-96-5	220	65	180	37	18.5	0.5	0.20	0.15			
Mercury	7439-97-6	0.1	1	2.3	0.161	0.0805	0.1	0.02	0.0			
Nickel	7440-02-0	38	130	150	3.11	1.555	0.5	0.10	0.06			
Potassium	7440-09-7	NC	NC	NC	359	179.5	100	20.00	10.00			
Selenium	7782-49-2	0.52	2.1	39	1.59	0.795	0.5	0.10	0.05			
Silver	7440-22-4	4.2	3.4	39	0.354	0.177	0.5	0.10	0.05			
Sodium	7440-23-5	NC	NC	NC	250	125	100	20.00	10.00			
Thallium	7440-28-0	1	0.28	0.078	NC	0.039	0.5	0.10	0.05			
Vanadium	7440-62-2	7.8	6	39	17.6	8.8	0.5	0.25	0.19			

SAP Worksheet #15-2—Reference Limits and Evaluation Table (continued)

Matrix: Composite Soil
Analytical Group: Metals and Chromium VI

Analyte	CAS Number	Ecological Screening Value (April 2012)[1,2] (mg/kg)	NCSSLs (Feb 2012)[1,2] (mg/kg)	Residential RSLs Adjusted (May 2012)[1,2] (mg/kg)	Background Undeveloped SS Combined Soil Type[1,2] (mg/kg)	Project Quantitation Limit Goal[2,3] (mg/kg)	Laboratory-specific (mg/kg)			LCS and MS/MSD Recovery Limits and RPD(%)[4]		
							LOQ	LOD	DL	LCL	UCL	RPD
Zinc	7440-66-6	46	1200	2300	28.6	14.3	2	1.00	0.68			
Chromium VI	18540-29-9	26	3.8	0.29	2.73	1.365	0.1	0.02	0.013	**80**	**120**	**30**

NC: No screening level for this compound.
[1]The Project Action Limit (PAL) is the BTV. If concentration exceed the BTV, data will be compared to the Ecological Screening Value, NCSSLs, and Residential RSLs Adjusted.
[2] PALs and Project QL Goals assume dry weight basis.
[3]The Project Quantitation Limit (PQL) Goal is 1/2 the BTV (Background Undeveloped SS Combined Soil Type).
[4] DoD QSM v.4.2 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.
Shading represents instances where the criterion is lower than the LOD. Non-detects will not be treated as exceedances though they will be reported at a value greater than the PQL Goal.

SAP Worksheet #15-3—Reference Limits and Evaluation Table

Matrix: Aqueous Blanks[1]

Analytical Group: Explosives, including Nitroglycerin, PETN, and Perchlorate

Analyte	CAS Number	Laboratory-specific (ug/l)			LCS and MS/MSD Recovery Limits and RPD(%)[2]		
		LOQ	LOD	DL	LCL	UCL	RPD
1,3,5-Trinitrobenzene	99-35-4	1.00	0.20	0.10	65	140	30
1,3-Dinitrobenzene	99-65-0	1.00	0.20	0.10	45	160	
2,4,6-Trinitrotoluene	118-96-7	1.00	0.20	0.16	50	145	
2,4-Dinitrotoluene	121-14-2	1.00	0.20	0.12	60	135	
2,6-Dinitrotoluene	606-20-2	1.00	0.20	0.10	60	135	
2-Amino-4,6-dinitrotoluene	35572-78-2	1.00	0.20	0.10	50	155	
2-Nitrotoluene	88-72-2	1.00	0.20	0.11	45	135	
3-Nitrotoluene	99-08-1	1.00	0.20	0.16	50	130	
4-Amino-2,6-dinitrotoluene	19406-51-0	1.00	0.20	0.20	55	155	
4-Nitrotoluene	99-99-0	1.00	0.20	0.10	50	130	
HMX	2691-41-0	1.00	0.20	0.10	80	115	
Nitrobenzene	98-95-3	1.00	0.20	0.10	50	140	
Nitroglycerin	55-63-0	125	62.5	33	**50**	**150**	
Pentaerythritol tetranitrate (PETN)	78-11-5	125	62.5	31	**50**	**150**	
RDX	121-82-4	1.00	0.20	0.16	50	160	
Tetryl	479-45-8	1.00	0.20	0.10	20	175	
Perchlorate	14797-73-0	0.5	0.20	0.10	**80**	**120**	**15**

[1]Aqueous blanks will not be compared to screening criteria values.

[2] DoD QSM v.4.2 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

SAP Worksheet #15-4—Reference Limits and Evaluation Table

Matrix: Aqueous Blanks[1]

Analytical Group: Metals and Chromium VI

Analyte	CAS Number	Laboratory-specific (ug/l)			LCS and MS/MSD Recovery Limits and RPD(%)[2]		
		LOQ	LOD	DL	LCL	UCL	RPD
Aluminum	7429-90-5	100	20	10			
Antimony	7440-36-0	1	0.5	0.25			
Arsenic	7440-38-2	1	0.2	0.1			
Barium	7440-39-3	1	0.5	0.25			
Beryllium	7440-41-7	1	0.1	0.05			
Cadmium	7440-43-9	1	0.2	0.1			
Calcium	7440-70-2	100	25	13			
Chromium	7440-47-3	1	0.2	0.1			
Cobalt	7440-48-4	1	0.2	0.1			
Copper	7440-50-8	1	0.5	0.25			
Iron	7439-89-6	100	10	5			
Lead	7439-92-1	1	0.1	0.05	80	120	20
Magnesium	7439-95-4	100	10	5			
Manganese	7439-96-5	1	0.2	0.1			
Mercury	7439-97-6	0.5	0.1	0.054			
Nickel	7440-02-0	1	0.2	0.1			
Potassium	7440-09-7	100	20	10			
Selenium	7782-49-2	1	0.3	0.15			
Silver	7440-22-4	1	0.2	0.1			
Sodium	7440-23-5	100	50	25			
Thallium	7440-28-0	1	0.2	0.1			
Vanadium	7440-62-2	1	0.5	0.25			
Zinc	7440-66-6	20	10	5			
Chromium VI	18540-29-9	0.2	0.10	0.05	**80**	**120**	**20**

[1]Aqueous blanks will not be compared to screening criteria values.

[2] DoD QSM v.4.2 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

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SAP Worksheet #16—Project Schedule / Timeline Table

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date of Initiation	Anticipated Date of Completion		
ESS					
Draft ESS	CH2M HILL	8/1/12	10/19/12	Draft ESS	10/19/12
Navy Chemist/ Navy/ Base Review	NAVFAC, MCIEAST – MCB CAMLEJ	10/22/12	11/16/12	Comments on Pre-Draft QAPP	
Final ESS	CH2M HILL	11/19/12	11/30/12	Final ESS	11/30/12
MR QAPP					
Pre-Draft MR QAPP	CH2M HILL	8/1/12	10/19/12	Pre-Draft QAPP	10/19/12
Navy Chemist/ Navy/ Base Review	NAVFAC, MCIEAST – MCB CAMLEJ	10/22/12	11/16/12	Comments on Pre-Draft QAPP	
Draft MR QAPP	CH2M HILL	11/19/12	11/30/12	Draft QAPP	11/30/12
Partnering Team Review	NAVFAC, MCIEAST- MCB CAMLEJ, USEPA, NCDENR, CH2M HILL	12/3/12	12/28/12	Comments on Draft QAPP	
Final MR QAPP	CH2M HILL	12/31/12	1/11/13	Final MR QAPP	1/11/13
Field Investigation					
Subcontractor Procurement	CH2M HILL	11/30/12	1/11/13		
Field Investigation	CH2M HILL, subcontractors (TBD)	1/14/13	4/16/13		
Phase II ESI Report					
Pre-Draft Phase II ESI Report	CH2M HILL	Second Quarter 2013	Third Quarter 2013	Draft Phase II ESI Report	Third Quarter 2013
Navy Chemist/ Navy/ Base Review	NAVFAC, MCIEAST – MCB CAMLEJ	Third Quarter 2013	Third Quarter 2013	Comments on Pre-Draft Phase II ESI Report	

SAP Worksheet #16—Project Schedule / Timeline Table (continued)

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date of Initiation	Anticipated Date of Completion		
Draft Phase II ESI Report	CH2M HILL	Third Quarter 2013	Third Quarter 2013	Draft Phase II ESI Report	Third Quarter 2013
Partnering Team Review	NAVFAC, MCIEAST- MCB CAMLEJ, USEPA, NCDENR, CH2M HILL	Third Quarter 2013	Fourth Quarter 2013	Comments on Draft Phase II ESI Report	
Final Phase II ESI Report	CH2M HILL	Fourth Quarter 2013	Fourth Quarter 2013	Final Phase II ESI Report	Fourth Quarter 2013

SAP Worksheet #17—Sampling Design and Rationale

The objective of this MR investigation is to evaluate the nature and extent of MEC/MPPEH at the investigation area at MRS Adjacent to Site UXO-21. This section of the QAPP details the specific DFOWs to be performed to meet the objectives of the investigation. The DFOWs and tasks to be performed during this investigation are presented in **Worksheet #14** and detailed as follows. The schedule of activities for the project is indicated in **Worksheet #16**. Each of these work elements for the investigation and other supporting documentation for performing the investigation are presented in the table as follows.

Definable Feature of Work Table	Supporting Document(s)
Pre-Mobilization Activities	QAPP, Scope of Work
Mobilization and Site Preparation	QAPP
Geophysical Survey	QAPP, GIP, Scope of Work
Geophysical Data Processing/ Interpretation	QAPP, GIP, Scope of Work
Intrusive Investigation	QAPP, Scope of Work, ESS
Demobilization	QAPP
Final Report and Closeout	QAPP, Scope of Work

Pre-Mobilization Activities

This QAPP has been developed to provide detail for how the project will be performed and the quality standards to which it will be compared. Prior to mobilization to the site, this plan will be reviewed and approved by CH2M HILL, the Navy, and the regulators. Additionally, coordination will be made to ensure GIS information and equipment are available and updated for project activities, document and data management procedures are in place, and all subcontractors have been procured. Subcontractor qualifications, certifications, and licenses will be reviewed prior to selection.

Mobilization and Site Preparation

All required field personnel, equipment, and materials will be mobilized to Site UXO-21. Onsite personnel will review this QAPP and all applicable SOPs and appendices. Appropriate site-specific training, including H&S review for site activities, geophysical survey training, and MEC Awareness Training will be verified or performed. Minimum training requirements are listed in **Worksheet #8**. Additionally, a morning safety meeting will be conducted each day to review the tasks to be performed that day and any potential hazards present.

All equipment will be inspected upon arrival at the site, will be tested for functionality, and will be repaired or replaced as necessary to ensure quality performance. Equipment inspections will also be performed daily throughout the project to ensure proper functionality and prevent any damage. Good housekeeping procedures will be followed to reduce the risk of equipment damage. Other equipment and requirements will be outlined in the Site-Specific HSP.

The FTL will ensure that onsite communications (such as mobile phones, two-way radios) have been established among team members.

Prior to the geophysical survey, vegetation clearing will be performed to facilitate site access. The geophysical survey area will be 1 meter wide transects throughout the MRS. These transects will be established to survey-grade accuracy by a professional land surveyor prior to the start of DGM.

SAP Worksheet #17—Sampling Design and Rationale (continued)

UXO qualified personnel will implement MEC avoidance measures to prevent unintentional contact with potential MEC during land surveying and vegetation clearing activities.

Geophysical Survey

After site-setup activities have been completed, DGM will be performed at the site. Note that required QC checks of the equipment, as described in **Worksheet #12,** the GIP (**Appendix B**), and the Geophysical Systems Verification Plan (**Appendix C**).

Geophysical Data Processing and Interpretation

See the **GIP**, included as **Appendix B,** for geophysical survey details. Once QC review of the geophysical data has been performed, the data will be evaluated for selection of targets that may represent potential MEC/MPPEH as detailed in **Section 3** of the **TMP** (**Appendix A)**.

Intrusive Investigation

If geophysical data collected indicate the presence of geophysical anomalies representing potential subsurface MEC, a MEC/MPPEH intrusive investigation will be performed on a select number of those anomalies. Anomalies will be intrusively investigated as, described **Section 3** of the **TMP** (**Appendix A**), which draws a statistically representative selection of anomalies from both higher density and lower density areas. The unexploded ordnance (UXO) Team performing MEC/MPPEH intrusive investigation and recovery will be composed of qualified UXO technicians supervised by a UXO Technician III. MR work will take place under the guidance of a Senior UXO Supervisor. Safety will be overseen by a UXO Safety Officer (UXOSO), and QC requirements will be implemented by a UXO Quality Control Specialist (UXOQCS). The MEC/MPPEH intrusive investigation will be performed as detailed in **Section 3** of the **TMP** (**Appendix A**).

Post-Detonation Soil Sample Collection

If a controlled detonation/BIP is performed, post-detonation surface soil samples will be collected according to **Section 2** of the **TMP** (**Appendix A**). If post-detonation soil samples are collected, the samples will be evaluated according to the Post-Detonation Data Evaluation Process shown in **Figure 6**. Since the type of specific item that may be found during the investigation is unknown, the analytical parameters include explosives residue, metals, and perchlorate. Hexavalent chromium is included because the risk screening process outlined in **Figure 6** uses the more conservative hexavalent chromium screening levels.

Quality Assurance and Quality Control

QA/QC requirements for environmental sampling, handling, and management are detailed in Section 4 of the MRP Master Project Plans (MPP) (CH2M HILL, 2008). Field QC samples will be collected according to Worksheet #12-3 during the investigation and submitted for laboratory analysis.

Sample Collection Frequencies

The number of surface soil samples will be based on the number of controlled detonation/BIP are performed. Two post-detonation composite soil samples will be collected at each location where intentional detonation or BIP has been performed as described in the **Technical Management Plan (TMP)** (**Appendix A**).

Sample Identification System

The following is a general guide for sample identification; an electronic sample–tracking program will be used to manage the flow of information from the field sampling team to the laboratory and to internal and external data users. The tracking program is used to manage the entry of sampling-related data, such as station locations and field measurements.

SAP Worksheet #17—Sampling Design and Rationale (continued)

While in the custody of the sampling team, the sample analysis data will be recorded in field logbooks, along with sample identity information.

Labels for samples to be shipped to a fixed-base laboratory will be produced electronically. If they cannot be produced electronically, they must be written legibly in indelible ink.

The following information typically is included on the sample label:

Site name or identifier
Unique sample identification number
Date and time of sample collection
Sampler's initials
Sample matrix or matrix identifier
Type of analyses to be conducted

Each field sample will be assigned a unique number using the formats noted on **Worksheet #18-2**. And which follow this sampling scheme:

Site# – Media/Station# and Q A/QC type- – inner or outer crater – Year/Quarter

An explanation of each of these identifiers is given below.

Site#: This investigation includes MMRP Site UXO-21 under the MRP; therefore, the prefix "MR21" will be used.

Media:

SS = Surface soil

Station#: Soil locations will be numbered consecutively.

QA/QC:

D = Duplicate sample (following sample type/number)
FB = Field blank
ER = Equipment rinsate
MS= Matrix Spike
MSD = Matrix Spike Duplicate

Year/Quarter#: Year/Quarter indicators will be used for all samples. Each round of sampling will have a distinct identification number:

"13" = Year 2013

"B" = Sampling during the second quarter

Under this sample designation format, "MR21-SS01-13B" would mean the following:

MR21-SS01-13B MMRP Site UXO-21

MR21-SS01-13B surface soil sample from post detonation location #1

MR21-SS01-13B sampling in the second quarter of year 2013

This sample designation format will be followed throughout the project. Required deviations to this format in response to field conditions will be documented in the field log book.

SAP Worksheet #17—Sampling Design and Rationale (continued)

Sample Packaging and Shipping

Samples will be packed in a cooler with bubble wrap packaging material and double-bagged ice. The samples will be either picked up at the site by the analytical laboratory or shipped to the laboratory via overnight courier. The FTL is responsible for the following activities related to shipment of the samples:

Verification that all sample bottles are correctly labeled, sealed, and packaged
Check to ensure that sample bottles in each cooler correspond to the accompanying chain-of-custody form
Affixing a custody seal to each cooler
Use of appropriate labels and forms required for shipment

Custody of the samples will be maintained and documented at all times. Chain-of-custody will begin with the collection of the samples in the field and will continue through the analysis of the sample at the analytical laboratory (samplers must transfer custody to the person responsible for shipping the samples).

Final Report and Closeout

At the conclusion of field activities and data processing and interpretation, a draft Phase II ESI report will be prepared to document the findings of the field investigation. The report will be submitted electronically for concurrent review by NAVFAC and MCIEAST-MCB CAMLEJ. Following receipt of review comments, CH2M HILL will issue a revised draft report to NAVFAC, MCIEAST-MCB CAMLEJ, USEPA, and NCDENR for review. A final report will be prepared that will address comments received on the draft document. The report will summarize the site history, field activities, and geophysical and environmental data (related to post denotation sampling) and will present the findings of the human health and ecological risk screening and/or assessments.

An After Action Report will be prepared in accordance with Naval Ordnance Safety and Security Activity (NOSSA) Instruction 8020.15c (NOSSA, 2011) to document the results of all MEC intrusive investigations conducted to date. The AAR will provide a summary of all MEC found during the investigations, summarize all MEC removal activities, and provide an evaluation of the selected removal methods and relative effectiveness.

SAP Worksheet #18-1—Sampling Locations and Methods and Standard Operating Procedure Requirements Table

Data collection activities performed at the site will include a geophysical investigation of the area as indicated on **Figure 7**.

Location	Exclusion Areas	Matrix	Depth relative to Ground Surface	Survey Methodology	Degree of Investigation or Coverage	SOP Reference
Investigation area	Jurisdictional wetlands	NA (not applicable)	Unknown	Geonics EM61-MK2	10% of the MRS	SOP #1

SAP Worksheet #18-2—Sampling Locations and Methods/SOP Requirements Table

Station ID	Sample ID[1]	Depth	Matrix	Analytical Group	Number of Samples[2]	Sampling SOP Reference
MR21-SS42	MR21-SS42-IC-12C	0-3 inches below ground surface (after detonation)	composite soil	Explosives including nitroglycerine and PETN, Perchlorate, TAL Metals, Hexavalent chromium	3 (MS/MSD)	Refer to **Worksheet #22**
	MR21-SS42-IC-12C-MS					
	MR21-SS42-IC-12C-SD					
	MR21-SS42-OC-12C				1	
	MR21-SS42-OCD-12C				1 (duplicate)	
MR21-SS43	MR21-SS43-IC-12C		composite soil		1	
	MR21-SS43-OC-12C				1	

Notes:

[1]The station IDs shown here assume 2 detonation locations, there may be more or fewer. If more than two detonation locations are sampled the station IDs, will be consecutively numbered. Refer to Worksheet #17 for a description of the sample identification scheme.

[2]Refer to Worksheet #12 for field QA/QC frequency.

SAP Worksheet #19—Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Containers (number, size, and type)	Sample Volume[2] (units)	Preservation Requirements (chemical, temperature, light-protected)	Maximum Holding Time[3] (preparation / analysis)
Composite Soil	Explosives	SW-846 8330A / EMAX-8330	4-oz jar	10g	Cool to ≤ 6°C	14 days until extraction; 40 days after extraction
	Explosives -PETN and Nitroglycerin	SW-846 8332 / EMAX-8332	4-oz jar	10g		14 days until extraction; 40 days after extraction
	Explosives - Perchlorate	SW-846 6850 /EMAX-6850		10g		28 days
	Metals	SW-846 6020A /EMAX-6020	4-oz jar	10g		6 months
	Metals - Mercury	SW-846 7471A /EMAX-7471A		5g		28 days
	Metals - Chromium VI	SW-846 7199 /EMAX-7199	4-oz jar	5g		Leaching: 28 days until preparation; 24 hrs after preparation Alkali Digestion: 30 days until preparation; 168 hrs after preparation
Aqueous Blanks	Explosives	SW-846 8330A /EMAX-8330	4 x 500mL amber	400mL	Cool to ≤ 6°C	7 days until extraction; 40 days after extraction
	Explosives -PETN and Nitroglycerin	SW-846 8332 /EMAX-8332		400mL		
	Explosives - Perchlorate	SW-846 6850 /EMAX-6850	1x125mL poly	10mL	Cool to ≤ 6°C	28 days
	Metals	SW-846 6020A / EMAX-6020	1x250mL poly	50mL	HNO3 to pH<2; Cool to ≤ 6°C	6 months
	Metals - Mercury	SW-846 7470A /EMAX-7470A		50mL		28 days
	Metals - Chromium VI	SW-846 7199 / EMAX-7199	1x125mL poly	20mL	Cool to ≤ 6°C	24 hours

[1]Refer to the Analytical SOP References table (Worksheet #23) for a list of laboratory SOPs.

[2]This is the minimum sample volume or mass requirement for a single analysis.

[3]Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

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SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations[1]	No. of Field Duplicates[2]	No. of Matrix Spike/Matrix Spike Duplicates (MS/MSD)[2]	No. of Equip. Blanks[2]	Total No. of Samples to Lab[1]
Composite Soil	Explosives (including PETN, Nitroglycerin, and Perchlorate)	4	1	1/1	1	8
	Metals (including Mercury and Chromium VI)	4	1	1/1	1	8

Notes:
[1] The number of samples to be collected (sampling locations) is dependent upon the number of detonation pads or BIP detonations. The number of samples shown here assume there will be 2 detonation locations.

[2] The QA/QC counts are dependent on the number of sampling locations, refer to **Worksheets #12-3** for details regarding field QA/QC frequency.

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SAP Worksheet #21—Project Sampling SOP References Table

Reference Number	Title, Revision Date, and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
TBD*	DGM Surveying	Geophysical Survey Subcontractor	Geonics EM61-MK2	TBD	TBD
1	Chain-of-Custody	CH2M HILL	Sample shipping and custody material	N	
2	Systematic Random Multi-Increment Sampling	CH2M HILL	Surface soil sample collection	N	

* SOP will be provided by the subcontractor upon award.

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SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

See also **Worksheet #12**.

Field Equipment	Activity[a]	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference	Comments
DGM Equipment Warm-up	Verification	At the beginning of each work day	System has warmed up for a minimum of 10 minutes (longer in cold weather)	Repair/replace equipment components until functioning properly.	Equipment operator	GIP (**Appendix B**)	QC Geophysicist to evaluate whether warm-up period was sufficient through data collection notes
DGM System Personnel Test	Testing	At the beginning of each work day	Data spikes no greater than 2 millivolts from the mean for the EM61-MK2.	Operator checks self for sources of metallic interference (such as cell phone, steel-toe boots); repair/replace equipment components until functioning properly.	Equipment operator	GIP (**Appendix B**)	QC Geophysicist to evaluate test compliance during daily data review
DGM System Cable Shake Test	Testing	At the beginning of each work day	Data spikes no greater than 2 millivolts from the mean for the EM61-MK2.	Repair/replace equipment components until functioning properly.	Equipment operator	GIP (**Appendix B**)	QC Geophysicist to evaluate test compliance during daily data review

[a] Activities may include: calibration, verification, testing, and/or maintenance.

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SAP Worksheet #23—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and Number	Date reviewed if not revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work?
EMAX-8330	Nitroaromatics & Nitramines by HPLC, Rev. 7	2/15/2012	Definitive	Explosives/Solids & Aqueous	HPLC	None	No
EMAX-8332	Nitroglycerine by HPLC, Rev. 1	6/29/2012	Definitive	Explosives/Solids & Aqueous	HPLC	None	No
EMAX-6850	Perchlorate by HPLC/MS, Rev. 0	08/30/2012	Definitive	Explosives/Solids & Aqueous	HPLC-MS	None	No
EMAX-6020	Trace Metals by ICP/MS, Rev. 7	11/14/2012	Definitive	Metals/Solids	ICP-MS	None	No
EMAX-7470A	Mercury, Rev. 6	8/30/2012	Definitive	Metals/Aqueous	Cold Vapor	None	No
EMAX-7471A	Mercury, Rev. 6	8/7/2012	Definitive	Metals/Solids	Cold Vapor	None	No
EMAX-7199	Chromium (IV), Rev. 3	11/20/2012	Definitive	Metals/Solids & Aqueous	IC	None	No
EMAX-3060	Alkaline Digestion for Hexavalent Chromium, Rev. 0	11/1/2012	Definitive	Metals/Solids & Aqueous	NA	None	No
EMAX-3010	Acid Digestion, Total Metals for Aqueous, Rev. 5	3/12/2012	Definitive	Metals in Water	NA	None	No
EMAX-3050	Acid Digestion, Total Metals for Solid, Rev. 4	8/13/2012	Definitive	Metals in Soil	NA	None	No
EMAX-SM02	Sample Receiving, Rev. 7	6/4/2012	NA	NA	NA	None	No
EMAX-SM05	Sample containers, Handling and shipping, Rev. 2	6/21/2012	NA	NA	NA	None	No

Note:
DoD ELAP certification is required for this work. EMAX's certification is current through January 10, 2014, a copy of the certificate is included as Appendix E.

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SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
HPLC/UV-vis (Explosives including PETN and Nitroglycerin)	Initial Calibration (ICAL) - minimum 5 calibration points for each analyte	Initial calibration prior to sample analysis and as needed.	One of the following options: 1) RSD for all analytes ≤20%; 2) linear – least squares regression r ≥0.995; 3) non-linear – co-efficient of determination (COD) ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Locate the source of the problem. If expected RSD is not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem, then repeat ICAL.	Analyst	EMAX-8330, EMAX-8332
	Second Source Calibration Verification (ICV)	Once, immediately following ICAL.	All project analytes within established retention time windows. All project analytes within ±15% of expected value from ICAL.	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persists, perform instrument adjustment and/or maintenance to correct the problem, then repeat ICAL.		
	Continuing Calibration Verification (CCV)	Daily, before sample analysis, after every 10 field samples, and at the end of analysis sequence.	All project analytes within established retention time windows. All project analytes within ±15% of expected value from ICAL.	Diagnose problem. Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persists, perform instrument adjustment and/or maintenance to correct the problem. Reanalyze all samples since last successful CCV. If problem persists, repeat ICAL.		
LC-MS - (Perchlorate)	Initial Calibration	Initial calibration prior to sample analysis and as needed.	One of the following options: 1) RSD for all analytes ≤ 20% 2) linear – least squares regression r ≥ 0.995	Locate the source of the problem. If expected RSD is not met, check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat ICAL.	Analyst	EMAX-6850
	Second Source Calibration Verification (ICV)	Once after each initial calibration.	All project analytes within ±15% of expected value from ICAL.	Prepare fresh standard and reanalyze second source to rule out standard degradation or inaccurate injection. If problem persists, perform instrument adjustment and/or maintenance, and rerun initial calibration and second source verification standard. If problem continues, new standards may need to be purchased, prepared, and analyzed.		
	Continuing Calibration Verification	Daily, before sample analysis, after every 10 field samples, and at the end of analysis sequence.	All project analytes within ±15% of expected value from ICAL.	Diagnose problem. Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem. Reanalyze all samples since last successful CCV.		
	LOD Verification (per batch); Perchlorate spike concentration approximately 2x LOD.	Prior to sample analysis and at the end of the sequence.	Within ±30% of expected value.	Diagnose and correct problem. If problem persists perform instrument adjustment and/or maintenance to correct the problem. Reanalyze all samples since last successful LODV. If a samples with perchlorate result between RL and LOD is bracketed by a failing LODV, it must be re-analyzed. Samples with concentrations above the LOQ can be reported.		

SAP Worksheet #24—Analytical Instrument Calibration Table (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP-MS (Metals)	Tuning	Prior to initial calibration.	Mass calibration ≤ 0.1 amu from the true value; Resolution <0.9 amu full width at 10% peak height; For stability, RSD ≤5% for at least four replicate analyses.	Retune instrument then reanalyze tuning solutions.	Analyst	EMAX-6020
	Initial Calibration - minimum one high standard and a calibration blank	Daily.	If more than one calibration standard is used, r≥ 0.995.	Locate the source of the problem. Check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem and then repeat initial calibration.		
	Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Correct the problem. Re-prepare and reanalyze the calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	Low Level Calibration Check Standard	Once after each initial calibration.	Value of all project analytes within 20% of true value.	Diagnose the problem. Prepare fresh standard and re-analyze to rule out standard degradation or inaccurate injection. If problem persists perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.		
	Second Source Calibration Verification (ICV)		Value of all project analytes within 10% of true value.	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.		
	Continuing Calibration Verification	After every 10 field samples, and at the end of analysis sequence.	Value of all project analytes within 10% of true value.	Diagnose problem. Prepare fresh standard and re-analyze CCV to rule out standard degradation or inaccurate injection. If problem persist perform instrument adjustment and/or maintenance to correct the problem. Reanalyze all samples since last successful CCV. If problem persists, repeat ICAL.		
	Interference Check Solutions (ICS)	At the beginning of an analytical run and every 12 hours.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ±20% of the true value.	Terminate analysis, locate and correct the problem, reanalyzed ICS, reanalyze all samples.		

SAP Worksheet #24—Analytical Instrument Calibration Table (continued)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
CVAA (Mercury)	Initial Calibration - minimum five standards and a calibration blank	Daily.	r ≥ 0.995.	Locate the source of the problem. Check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem and then repeat initial calibration.	Analyst	EMAX-7470, EMAX-7471
	Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD.	Correct the problem. Re-prepare and reanalyze the calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	Second Source Calibration Verification (ICV)	Once after each initial calibration.	Value of all project analytes within 10% of true value.	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persists perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.		
	Continuing Calibration Verification	After every 10 field samples, and at the end of analysis sequence.	Value of all project analytes within 20% of true value.	Prepare fresh standard and re-analyze ICV to rule out standard degradation or inaccurate injection. If problem persists perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.		
IC (Chromium VI)	Initial Calibration -	Initial calibration prior to sample analysis and as needed.	r ≥0.995	Locate the source of the problem. Check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat initial Calibration	Analyst	EMAX-7199
	Second Source Calibration Verification (ICV)	Once after each initial calibration.	All project analytes within ±10% of expected value from ICAL.	Prepare fresh standard and re-analyze ICV to rule out standard degradation. If problem persist perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.		
	Continuing Calibration Verification	Daily, before sample analysis, after every 10 field samples, and at the end of analysis sequence.	All project analytes within ±10% of expected value from ICAL.	Diagnose problem. Prepare fresh standard and re-analyze CCV to rule out standard degradation. If problem persist perform instrument adjustment and/or maintenance to correct the problem. Reanalyze all samples since last successful CCV. If problem persists, repeat ICAL.		

Notes:

DoD QSM v. 4.2 is the basis for the information in this table, except for Chromium VI analysis, for which the basis is the laboratory SOP.

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SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
HPLC/UV-vis (Explosives)	Detector Maintenance	Instrument Performance Checks	Inspect flow cell for leaks.	Daily prior to analysis.	No deficiencies.	Repair or replace as needed. Document all actions in log book.	Analyst	EMAX-8330, EMAX-8332
	LC Pump Maintenance	Instrument Performance Checks	Replace pump head seal, purge valve seal, and filter assembly frits. Perform leak test.	Every Six months or as necessary.	No defects.	Replacement of internal components as needed.		
	Preventive Maintenance	System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector.	Every 6 months or as needed.	No defects.	Clean as needed.		
	Parameter Set-up	Physical Check	Various - Check Autosampler, HPLC settings, temperature programs, etc.	Initially, prior to each use.	Set-up in accordance to SOP guides.	Reset to SOP requirements.		
LC-MS - (Explosives - Perchlorate)	Preventive Maintenance	System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector.	Every 6 months or as needed.	No defects.	Clean as needed.	Analyst	EMAX-6850
	Parameter Set-up	Physical Check	Various - Check Autosampler, Check pressure, effluent, detector, flow rate as set per SOP.	Initially, prior to each use.	Set-up in accordance to SOP guides.	Reset to SOP requirements		

SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP-MS (Metals)	Parameter Setup	Physical check	Check that the autosampler is functioning as expected	Initially; prior to each use	Autosampler must move to the expected position when activated.	Reset autosampler if problem persist perform autosampler troubleshooting prior to instrument use.	Analyst	EMAX-6020
			Check pump rate		Pump rate: 0.08 – 0.12 rps	Adjust pump rate if necessary otherwise perform pump trouble-shooting.		
			Check nebulizer gas flow		Nebulizer gas flow: 1.05-1.25 L/min	Adjust if gas flow as needed otherwise perform instrument troubleshooting.		
			Check rinse bottle		Rinse bottle: Filled to mark	Fill rinse bottle to mark.		
	Tune Check	Instrument Performance	Conformance to instrument tuning.	Initially; prior to ICAL	Compliance to ion abundance criteria as specified by the method.	Repeat tune check to rule out standard degradation or inaccurate injection. If problem persists, retune the instrument and repeat tune check.		

SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
	Initial calibration blank / continuing calibration blank	Instrument Performance	Instrument contamination check	After every calibrationVerification – Before samples, after every 10, and at the end of sequence.	No analytes detected ≥ LOD	Determine possible source of contamination and apply appropriate measure to correct the problem. Reanalyze calibration blank and all associated samples.		
CVAA (Metals - Mercury)	Initial Calibration Blank, Continuing Calibration Blank	Instrument Performance	Instrument contamination check.	After every calibration Verification – Before samples, after every 10, and at the end of sequence.	No analytes detected ≥ LOD	Determine possible source of contamination and apply appropriate measure to correct the problem. Reanalyze calibration blank and all associated samples.	Analyst	EMAX-7470, EMAX-7471
	Parameter Set-up	Physical Check	Various - Check Autosampler, GC settings, temperature programs, etc.	Initially, prior to each use.	Set-up in accordance to SOP guides.	Reset to SOP requirements.		

SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
IC (Metals - Chromium VI)	Check pump for leaks and spills; check air lines for crimping or discoloration.	Instrument performance checks	Visual inspection.	Initially, prior to each use.	No defects.	Replace areas as needed.	Analyst	EMAX-7199
	Preventive Maintenance	System Cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector.	Every 6 months or as needed.	No defects.	Clean as needed.		
	Parameter Set-up	Physical Check	Various - Check Autosampler, Check pressure, effluent, detector, flow rate as set per SOP.	Initially, prior to each use.	Set-up in accordance to SOP guides.	Reset to SOP requirements		

SAP Worksheet #26—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT

Sample Collection (Personnel/Organization): Field Team/CH2M HILL

Sample Packaging (Personnel/Organization): FTL/ CH2M HILL

Coordination of Shipment (Personnel/Organization): FTL/ CH2M HILL

Type of Shipment/Carrier: Overnight Carrier/ FedEx

SAMPLE RECEIPT AND ANALYSIS

Sample Receipt (Personnel/Organization): Logins/EMAX Labs

Sample Custody and Storage (Personnel/Organization): Logins EMAX Labs

Sample Preparation (Personnel/Organization): Inorganic Prep and Organic Prep/ EMAX Labs

Sample Determinative Analysis (Personnel/Organization): Analysts/ EMAX Labs

SAMPLE ARCHIVING

Field Sample Storage (No. of days from sample collection): 45

Sample Extract/Digestate Storage (No. of days from extraction/digestion): 45

Microbial Sample Storage (No. of days from sample collection): NA

SAMPLE DISPOSAL

Personnel/Organization: Sample Custody Personnel/ EMAX Labs

Number of Days from Analysis: 45

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SAP Worksheet #27—Sample Custody Requirements Table

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Samples will be collected by field team members under the supervision of the FTL. As samples are collected, they will be places into containers and labeled. Labels will be taped to the jar to ensure they do not separate. Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples 4 ± 2°C until they are received by the laboratory.

The chain of custody will be placed into the cooler in a Ziploc bag. Coolers will be taped up and shipped to the laboratories via FedEx overnight, with the air bill number indicated on the chain of custody (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples to CH2M HILL.

See **Worksheet #21** for SOPs containing sample chain of custody guidance.

The CH2M HILL field team will ship all environmental samples directly to the laboratory performing the analysis (EMAX Labs)

Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):

Laboratory custody procedures can be found in the following SOP, which is referenced in Worksheet #23, and can be provided upon request, EMAX SOP EMAX-SM02.

Sample Identification Procedures:

Sample labels will include, at a minimum the information specified on **Worksheet #17.**

Chain-of-custody Procedures:

Chains of custody will include, at minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID. Date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain of custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the Laboratory Information Management Systems (LIMS) database for each sample.

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SAP Worksheet #28-1—Laboratory QC Samples Table

Matrix: Composite Soil
Analytical Group: Explosives (including PETN and Nitroglycerin)
Analytical Method/SOP Reference: SW-846 8330A, SW-846 8332 / EMAX-8330, EMAX-8332

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparation batch.	No analytes detected > ½LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	EMAX Chemist	Contamination	Same as Method/SOP QC Acceptance Limits.
Laboratory Control Sample (LCS)		Refer to **Worksheet 15-1.**	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
Matrix Spike/Matrix Spike Duplicate (MS/MSD)	One per twenty samples.	Same as LCS and refer to **Worksheet 15-1**.	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy/Bias/Precision	
Surrogates	Every analytical sample	*1,2-Dichlorobenzene recovery within 60-140%.*	Correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.		Accuracy/Bias	

Notes:
DoD QSM v. 4.2 is the basis for the information in this table.
Where DoD QSM does not specify QC Acceptance limits, laboratory limits are shown in italics.

SAP Worksheet #28-2—Laboratory QC Samples Table

Matrix: Composite Soil
Analytical Group: Explosives - Perchlorate
Analytical Method/SOP Reference: SW-846 6850 / EMAX-6850

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	Analyst	Contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per preparation batch	Refer to **Worksheet 15-1.**	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
MS/MSD	One per twenty samples.	Same as LCS and refer to **Worksheet 15-1.**	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy/Bias/Precision	
Isotope Ratio $^{35}Cl/^{37}Cl$	Every sample, batch QC and standard.	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantitated. Theoretical ratio ~ 3.06. Must fall within 2.3 to 3.8.	If criteria are not met, the sample must be rerun. If the sample was not pretreated, the sample should be reextracted using cleanup procedures. If, after cleanup, the ratio still fails, use alternative techniques to confirm interference, etc.		Accuracy	

SAP Worksheet #28-2—Laboratory QC Samples Table (continued)

Matrix: Composite Soil
Analytical Group: Explosives - Perchlorate
Analytical Method/SOP Reference: SW-846 6850 / EMAX-6850

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Internal Standard	Addition of ^{18}O-labeled perchlorate to every sample.	Measured ^{18}O IS area within ±50% of the value from the average of the IS area counts of the ICAL. RRT of the perchlorate ion must be 1.0 ± 2% (0.98-1.02)	Rerun the sample at increasing dilutions until the 50% acceptance criteria are met. If criteria cannot be met with dilution, the interference are suspected and the sample must be reprepped using additional pretreatment steps.		Accuracy/Bias	
Interference Check Sample	One per ICS is prepared with every batch of 20 samples and undergoes the same preparation and pretreatment steps as the samples in the batch. At least one ICS must be analyzed daily.	Within ±30% of true value.	Terminate analysis. Reanalyze ICS to rule out standard degradation or inaccurate injection. If problem persist, perform instrument maintenance, repeat calibrations and reanalyze all associated samples. Potential issues include cleanup columns and analytical column.		Accuracy	

Notes:
DoD QSM v. 4.2 is the basis for the information in this table.

SAP Worksheet #28-3—Laboratory QC Samples Table

Matrix: Composite Soil
Analytical Group: Metals
Analytical Method/SOP Reference: SW-846 6020A / EMAX-6020

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > ½LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	Analyst	Contamination	Same as Method/SOP QC Acceptance Limits.
LCS		See **Worksheet 15-2**.	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
MS/MSD	One per twenty samples.	Same as LCS and see **Worksheet 15-2.**	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy/Bias/Precision	
Dilution Test	One per preparatory batch when any sample shows concentrations >50x the LOQ	Five-fold dilution must agree within ± 10% of the original determination.	Perform post-digestion spike addition.		Accuracy/Bias	
Post-digestion Spike	When Dilution Test fails or analyte concentration in all samples < 50x LOD.	Recovery within 75-125% of expected value.	Run all samples by method of standard addition (MSA).		Accuracy/Bias/Precision	

Notes:
DoD QSM v. 4.2 is the basis for the information in this table.

SAP Worksheet #28-4—Laboratory QC Samples Table

Matrix: Composite Soil
Analytical Group: Metals - Mercury
Analytical Method/SOP Reference: SW-846 7471A / EMAX-7471

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > ½LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	Analyst	Contamination	Same as Method/SOP QC Acceptance Limits.
LCS		See **Worksheet 15-2**.	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
MS/MSD	One per twenty samples.	See **Worksheet 15-2**.	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy/Bias/Precision	
Dilution Test	One per preparatory batch when any sample shows concentrations >50x the LOQ	Five-fold dilution must agree within ± 10% of the original determination.	Perform post-digestion spike addition.		Accuracy/Bias	
Post-digestion Spike	When Dilution Test fails or analyte concentration in all samples < 50x LOD.	Recovery within 75-125% of expected value.	Run all samples by method of standard addition (MSA).		Accuracy/Bias/Precision	

Notes:
DoD QSM v. 4.2 is the basis for the information in this table.

SAP Worksheet #28-5—Laboratory QC Samples Table

Matrix: Composite Soil
Analytical Group: Metals - Chromium VI
Analytical Method/SOP Reference: SW-846 7199 / EMAX-7199

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	One per preparatory batch	No analytes detected > ½LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	Analyst	Contamination	Same as Method/SOP QC Acceptance Limits.
LCS		See **Worksheet 15-2.**	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
MS or Duplicate	One per twenty samples.	*Recovery of 75-125%; RPD 30%.*	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy/Bias/Precision	

Notes:

DoD QSM v. 4.2 is the basis for the information in this table.
Where DoD QSM does not specify QC Acceptance limits, laboratory limits are shown in italics.

SAP Worksheet #28-6—Laboratory QC Samples Table

Matrix: Aqueous Blanks
Analytical Group: Explosives (including PETN and Nitroglycerin)
Analytical Method/SOP Reference: SW-846 8330A, SW-846 8332 / EMAX-8330, EMAX-8332

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparation batch.	No analytes detected > ½LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	EMAX Chemist	Contamination	Same as Method/SOP QC Acceptance Limits.
LCS		Refer to **Worksheet 15-3.**	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
MS/MSD	One per twenty samples.	Same as LCS and refer to **Worksheet 15-3**.	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy/Bias/Precision	

SAP Worksheet #28-6—Laboratory QC Samples Table (continued)

Matrix: Aqueous Blanks
Analytical Group: Explosives (including PETN and Nitroglycerin)
Analytical Method/SOP Reference: SW-846 8330A, SW-846 8332 / EMAX-8330, EMAX-8332

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Surrogates	Every analytical sample	*1,2-Dichlorobenzene recovery within 60-140%.*	Correct problem then reprep and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.		Accuracy/Bias	

Notes:
DoD QSM v. 4.2 is the basis for the information in this table.
Where DoD QSM does not specify QC Acceptance limits, laboratory limits are shown in italics.

SAP Worksheet #28-7—Laboratory QC Samples Table

Matrix: Aqueous Blanks
Analytical Group: Explosives - Perchlorate
Analytical Method/SOP Reference: SW-846 6850 / EMAX-6850

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparation batch	No analytes detected > ½LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	Analyst	Contamination	Same as Method/SOP QC Acceptance Limits.
LCS	One per preparation batch	Refer to **Worksheet 15-3.**	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
MS/MSD	One per twenty samples.	Same as LCS and refer to **Worksheet 15-3**.	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy/Bias/Precision	
Isotope Ratio $^{35}Cl/^{37}Cl$	Every sample, batch QC and standard.	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantitated. Theoretical ratio ~ 3.06. Must fall within 2.3 to 3.8.	If criteria are not met, the sample must be rerun. If the sample was not pretreated, the sample should be reextracted using cleanup procedures. If, after cleanup, the ratio still fails, use alternative techniques to confirm interference, etc.		Accuracy	

SAP Worksheet #28-7—Laboratory QC Samples Table (continued)

Matrix: Aqueous Blanks
Analytical Group: Explosives - Perchlorate
Analytical Method/SOP Reference: SW-846 6850 / EMAX-6850

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Internal Standard	Addition of ^{18}O-labeled perchlorate to every sample.	Measured ^{18}O IS area within ±50% of the value from the average of the IS area counts of the ICAL. RRT of the perchlorate ion must be 1.0 ± 2% (0.98-1.02)	Rerun the sample at increasing dilutions until the 50% acceptance criteria are met. If criteria cannot be met with dilution, the interference are suspected and the sample must be reprepped using additional pretreatment steps.		Accuracy/Bias	
Interference Check Sample	One per ICS is prepared with every batch of 20 samples and undergoes the same preparation and pretreatment steps as the samples in the batch. At least one ICS must be analyzed daily.	Within ±30% of true value.	Terminate analysis. Reanalyze ICS to rule out standard degradation or inaccurate injection. If problem persist, perform instrument maintenance, repeat calibrations and reanalyze all associated samples. Potential issues include cleanup columns and analytical column.		Accuracy	

Notes:
DoD QSM v. 4.2 is the basis for the information in this table.

SAP Worksheet #28-8—Laboratory QC Samples Table

Matrix: Aqueous Blanks
Analytical Group: Metals
Analytical Method/SOP Reference: SW-846 6020A / EMAX-6020

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > ½LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	Analyst	Contamination	Same as Method/SOP QC Acceptance Limits.
LCS		See **Worksheet 15-4**.	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
MS/MSD	One per twenty samples.	Same as LCS and see **Worksheet 15-4.**	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy/Bias/Precision	
Dilution Test	One per preparatory batch when any sample shows concentrations >50x the LOQ	Five-fold dilution must agree within ± 10% of the original determination.	Perform post-digestion spike addition.		Accuracy/Bias	
Post-digestion Spike	When Dilution Test fails or analyte concentration in all samples < 50x LOD.	Recovery within 75-125% of expected value.	Run all samples by method of standard addition (MSA).		Accuracy/Bias/Precision	

Notes:
DoD QSM v. 4.2 is the basis for the information in this table.
Where DoD QSM does not specify QC Acceptance limits, laboratory limits are shown in italics.

SAP Worksheet #28-9—Laboratory QC Samples Table

Matrix: Aqueous Blanks
Analytical Group: Metals - Mercury
Analytical Method/SOP Reference: SW-846 7470A / EMAX-7470

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > ½LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	Analyst	Contamination	Same as Method/SOP QC Acceptance Limits.
LCS		See **Worksheet 15-4**.	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
MS/MSD	One per twenty samples.	See **Worksheet 15-4**.	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy/Bias/Precision	
Dilution Test	One per preparatory batch when any sample shows concentrations >50x the LOQ	Five-fold dilution must agree within ± 10% of the original determination.	Perform post-digestion spike addition.		Accuracy/Bias	
Post-digestion Spike	When Dilution Test fails or analyte concentration in all samples < 50x LOD.	Recovery within 75-125% of expected value.	Run all samples by method of standard addition (MSA).		Accuracy/Bias/Precision	

Notes:
DoD QSM v. 4.2 is the basis for the information in this table.

SAP Worksheet #28-10—Laboratory QC Samples Table

Matrix: Aqueous Blanks
Analytical Group: Metals - Chromium VI
Analytical Method/SOP Reference: SW-846 7199 / EMAX-7199

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch	No analytes detected > ½LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). For common laboratory contaminants, no analytes detected > LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	Analyst	Contamination	Same as Method/SOP QC Acceptance Limits.
LCS		See **Worksheet 15-4**.	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
MS or Duplicate	One per twenty samples.	*Recovery of 75-125%; RPD 20%.*	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract / reanalyze the sample.		Accuracy/Bias/Precision	

Notes:
DoD QSM v. 4.2 is the basis for the information in this table.
Where DoD QSM does not specify QC Acceptance limits, laboratory limits are shown in italics.

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SAP Worksheet #29—Project Documents and Records Table

Document/Report/Form	Generator	Definable Feature of Work	Frequency of Completion	Location/Where Maintained
Field Notebook	CH2M HILL FTL	All Fieldwork	Daily	Hard copy onsite then in project file, copies saved on CH2M HILL's local server
Fieldwork Plans	CH2M HILL	Pre-mobilization activities	Once prior to beginning fieldwork	Hard copy onsite then in project file, copies saved on CH2M HILL's local server
CA Forms	CH2M HILL	All Fieldwork	As necessary	CH2M HILL's local server and project file
Electronic Data Deliverables	CH2M HILL and Geophysical Survey Subcontractor	Geophysical Survey/Data Transfer	As necessary based upon data collection	CH2M HILL's local server
Meteorological Data from Field	CH2M HILL	All Fieldwork	Daily	Field Notebook
Equipment/Instrument check logs	CH2M HILL and Geophysical Survey Subcontractor	Geophysical Survey	As required by this QAPP	Hard copy onsite then in project file, copies saved on CH2M HILL's local server
Geophysical Survey subcontractor notes and field logs	Geophysical Survey Subcontractor	Geophysical Survey	Daily	Onsite then transfer copy to CH2M HILL to store on local server
Pre-Processed Data	CH2M HILL and Geophysical Survey Subcontractor	Geophysical Survey and Data Evaluation	As necessary	Subcontractor data base and CH2M HILL local server
Final Geophysical Survey Data	CH2M HILL and Geophysical Survey Subcontractor	Geophysical Survey and Data Evaluation	As necessary	Subcontractor data base and CH2M HILL local server
Field Photo Log*	CH2M HILL	All Fieldwork	Daily/As necessary	CH2M HILL local server
Daily Project Reports	CH2M HILL	All Fieldwork	Daily	CH2M HILL's local server, hard copy onsite then in project file
Daily H&S Documents	CH2M HILL	All Fieldwork	Daily	CH2M HILL's local server, hard copy onsite then in project file
Training Records	CH2M HILL and Geophysical Survey Subcontractor	All Fieldwork	Prior to mobilization to the site	Hard copy onsite

SAP Worksheet #29—Project Documents and Records Table (continued)

Document/Report/Form	Generator	Definable Feature of Work	Frequency of Completion	Location/Where Maintained
Meeting Agendas, Minutes, Presentation, and so forth	CH2M HILL	All Definable Features of Work	As necessary	CH2M HILL local server
Summary Reports	CH2M HILL	Final Reports and Closeout	Once upon completion of site activities	CH2M HILL local server
Anomaly Tracking (paper forms or electronic data management system using hand held devices)	CH2M HILL	Intrusive Investigation	For each anomaly representing potential MEC investigated	Hard copy/electronic management system onsite, then in project file, copies saved on CH2M HILL's local server
DD Form 1348-1	CH2M HILL	Demilitarization of MDAS	For each MDAD item demilitarized	Hard copy onsite then in project file, copies saved on CH2M HILL's local server

SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory/Organization	Backup Laboratory / Organization
Composite Soil & Aqueous Blanks	Explosives	Refer to **Worksheet#18**	SW-846 8330A	28 Calendar days	EMAX 1835 West 205th Street Torrance, CA 90501 (310) 618-8889	TBD
	Explosives -PETN and Nitroglycerin		SW-846 8332			
	Explosives - Perchlorate		SW-846 6850			
	Metals		SW-846 6020A			
	Metals - Mercury		SW-846 7470A/7471A			
	Metals - Chromium VI		SW-846 7199			

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SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Field Performance Audit	Project subject to audit and may be conducted during field event	Internal	CH2M HILL	FTL and or Geophysicist	FTL, Geophysical Subcontractor	FTL, Geophysical Subcontractor	CH2M HILL
Data storage and transfer system check	Prior to initial data collection and once weekly	Internal	CH2M HILL	CH2M HILL Geophysicist	Geophysical Subcontractor	Geophysical Subcontractor	CH2M HILL

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SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field Performance Audit	Checklist and Written Audit Report	Dan Hockett/CLT PM, CH2M HILL	Within 1 week of audit	Memorandum	CH2M HILL FTL CH2M HILL Geophysicist	Within 1 week of receipt of CA Form

SAP Worksheet #32-1—Laboratory Corrective Action Form

Person initiating CA _____ Date _____

Description of problem and when identified (Submit a drawing or sketch if necessary): _____

Cause of problem, if known or suspected: _____

Resolution/Sequence of CA: (including date implemented, action planned, and personnel/data affected) _____

CA implemented by: _____ Date: _____

CA initially approved by: _____ Date: _____

Follow-up date: _____

Final CA approved by: _____ Date: _____

Information copies to: Anita Dodson/CH2M HILL Navy CLEAN Program Chemist

SAP Worksheet #32-2—Field Performance Audit Checklist

Project Responsibilities

Project No.: _____ Date: _____

Project Location: _____ Signature: _____

Team Members:

Yes _ No _ 1) Is the approved work plan being followed?
Comments _____

Yes _ No _ 2) Was a briefing held for project participants?
Comments _____

Yes _ No _ 3) Were additional instructions given to project participants?
Comments _____

DGM Operations

Yes _ No _ 1) Are routine inspections and QC checks of the equipment being performed as outlined in this QAPP?
Comments _____

Yes _ No _ 2) Is the proposed location of grid lines clearly communicated with the DGM Survey Team?
Comments _____

Yes _ No _ 3) Are data collection being performed as required by the QAPP?
Comments _____

Yes _ No _ 4) Are data stored properly and uploaded for transfer in a timely manner?
Comments _____

SAP Worksheet #32-2—Field Performance Audit Checklist (continued)

Yes _ No _ 5) Are photographs taken and documented?
Comments _____

_____

Document/Data Control

Yes _ No _ 1) Are all work plan documents available onsite for review?
Comments _____

_____

Yes _ No _ 2) Are daily reports and other documentation completed as required by the QAPP?
Comments _____

_____

Yes _ No _ 3) Are equipment QC data and collected field data properly transferred? Review?
Comments _____

SAP Worksheet #33—QA Management Reports Table

Type of Report	Frequency	Projected Delivery Date	Person Responsible for Report Preparation	Report Recipient(s)
Daily QC Report	Daily	Following Day	Site QC Manager	Dan Hockett/CH2M HILL
QC Meeting Minutes	Post Meeting	Within 7 days	Site QC Manager	Dan Hockett/CH2M HILL
Preparatory Inspection Forms	Once for each applicable definable feature of work (prior to start of task)	With daily reports the following day after meeting	Site QC Manager	Dan Hockett/CH2M HILL
Initial Inspection Forms	Once for each applicable definable feature of work (prior to start of task)	With daily reports the following day after meeting	Site QC Manager	Dan Hockett/CH2M HILL
Follow-Up Inspection Forms	Once for each applicable definable feature of work (document in daily reports)	Document in Daily Reporting	Site QC Manager	Dan Hockett/CH2M HILL
Draft Phase II ESI Report	Post Field Event	Fourth Quarter 2013	Dan Hockett/CH2M HILL	Stakeholders, see **Worksheet #4**

The Phase 2 ESI Report will address the following:

Summary of project QA/QC requirements and procedures
Conformance of project to the QAPP requirements and procedures
Deviations from the QAPP and any approved amendments
Summary of the identity and extent of MEC/MPPEH
Documentation of disposition of all recovered MEC/MPPEH
Documentation of disposal of all resulting MDAS
Conclusions and recommendations for path forward

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SAP Worksheet #34-1—MR Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification
Evidence of required approval of plan (QAPP)	Evidence of approval and completeness of QAPP. Includes establishment of PQOs, QC criteria, SOPs, PALs, figures, and so forth.	Internal	Daniel Hockett, CH2M HILL
Site-Specific Training Records	Ensure project personnel have proper training and certification to perform site activities and achieve project data quality objectives.	Internal	FTL, CH2M HILL
Geophysical Survey Data Methods	Geophysical survey data methods will be reviewed to ensure data collection is performed as defined in the QAPP.	Internal	FTL and Geophysicist CH2M HILL
Data Collection and Transfer	Ensure data collection is complete and recorded accurately and that data transfer protocol is adequate.	Internal	Daniel Hockett, CH2M HILL
Performance requirements (including QC criteria)	Ensure performance requirements are fully established (see **Worksheet #12-1b** and **Worksheet #15**).	Internal	Geophysicist, CH2M HILL
Field Log Notebooks	Field notes will be reviewed to ensure completeness of field data collection, data collection times, site operations, site conditions, and so forth. The logbook will also be used to document, explain, and justify all deviations from the approved QAPP and other work planning documents.	Internal	FTL and Daniel Hockett, CH2M HILL

SAP Worksheet #34-2– Lab Data Verification (Step I) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Planning Documents	Evidence of approval and completeness of UFP-SAP.	Internal	Dan Hockett (PM)/CH2M HILL
Chain of Custody and shipping forms	COC forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the COC will be initialed by the reviewer, a copy of the COC retained in the site file, and the original and remaining copies taped inside the cooler for shipment. See COC SOP (on CD) for further details.	Internal	FTL/CH2M HILL Clairette Campbell (PC)/CH2M HILL
Field Log Notebooks	Field notes will be reviewed to ensure completeness of field data parameters, shipping information, sample collection times, etc. The logbook will also be used to document, explain, and justify all deviations from the approved work plan and UFP-SAP.	Internal	Dan Hockett (PM)/CH2M HILL
Sample Login/ Receipt	Upon their arrival at the laboratory, the samples will be cross-referenced against the COC records. All sample labels will be checked against the COC, and any mislabeling will be identified, investigated, and corrected. The samples will be logged in at every storage area and work station required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms.	Internal	Sample Receipt Personnel/EMAX
QC Summary Report	A summary of all QC sample results will be verified for completeness once the data is received from the laboratory.	External	Clairette Campbell (PC)/CH2M HILL

SAP Worksheet #35-1—MR Validation (Steps IIa and IIb) Process Table

Step IIa[a] / IIb[b]	Validation Input	Description	Responsible for Validation (name, organization)
IIb	Onsite Screening	Ensure that all field data meet work plan requirements for completeness and accuracy based on the field calibration records.	FTL, CH2M HILL
IIa	Geophysical Survey Data Methods	Verify that all data collected were in accordance with the SOPs and requirements of the QAPP. Ensure that any deviations from the QAPP are documented.	FTL and Geophysicist, CH2M HILL
IIa	Data Collection and Transfer	Ensure that all data are usable and have been corrected in accordance with data processing procedures defined in the SOPs.	Geophysicist, CH2M HILL
IIa	Performance Requirements (including QC criteria)	Establish that QC tests were performed and compliant with method-required limits as specified in **Worksheet #12-1b**.	FTL and Geophysicist, CH2M HILL
IIa	Field Log Notebooks	Review field logbooks, field documents, and data deliverables for compliance to methods and signatures.	FTL and PM, CH2M HILL
IIb	Performance Requirements (including QC criteria)	Ensure that the data report has been provided and that all data are complete. Evaluate whether all data collection procedures were followed with respect to the equipment and QC process.	Geophysicist, CH2M HILL

[a] IIa = compliance with methods, procedures, and contracts. [b] IIb = comparison with measurement performance criteria in the QAPP.

SAP Worksheet #35-2— Lab Data Validation (Steps IIa and IIb) Process Table

Step IIa / IIb[1]	Validation Input	Description	Responsible for Validation (name, organization)
IIa	SOPs	Review field logbooks, laboratory case narratives, data deliverables for compliance to methods and signatures.	FTL /CH2M HILL Dan Hockett (PM)/CH2M HILL
IIa	QC Results	Establish that all field and lab QC samples were run and compliant with method-required limits as specified in Worksheets #12 and 28.	Laura Maschhoff (DV)/DataQual
IIb	QC Results	Verify that QC samples were run and compliant with limits established in the UFP-SAP.	Clairette Campbell (PC)/CH2M HILL
IIb	Project QLs	Ensure all sample results met the project quantification and action limits specified in Worksheet #15.	Clairette Campbell (PC)/CH2M HILL
IIb	Raw data	10 percent review of raw data to confirm laboratory calculations.	Laura Maschhoff (DV)/DataQual

[1] IIa=compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005.]
IIb=comparison with measurement performance criteria in the SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005]

SAP Worksheet #36—Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa and IIb	Composite Soil & Aqueous Blanks	Explosives (including PETN, Nitroglycerin, and PETN) and Metals (including Mercury and Chromium VI)	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should there be any exceedances, data may be qualified. The data qualifiers that will be used are those presented in *National Functional Guidelines for Organic Data Review (USEPA, 1999) or National Functional Guidelines for Inorganic Data Review (USEPA, 2004)*, as appropriate. National Functional Guidelines will not be used for DV, per se; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this SAP be identified.	Laura Maschhoff (DV)/DataQual

[1] Verification (Step I) is a completeness check that is performed before the data review process continues in order to determine whether the required information (complete data package) is available for further review. Validation (Step IIa) is a review that the data generated is in compliance with analytical methods, procedures, and contracts. Validation (Step IIb) is a comparison of generated data against measurement performance criteria in the SAP (both sampling and analytical).

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SAP Worksheet #37—Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms, that will be used:

In general, if all QC criteria are met, then the data are considered usable. However, as described below, data usability is determined by the Navy, MCIEAST-MCB CAMLEJ, NCDENR, and USEPA.

If QC criteria are not met for MR data, then they are suspect and cannot be used until confirmed. Recollection of data may be required.

If QC criteria are not met for analytical data, then qualifiers may be applied during data validation. These may include:

- U – Not detected or not detected at significantly greater than that in an associated blank.
- UJ – Nondetect. Estimated reporting limit.
- J – Estimated.
- NJ – Tentatively identified.
- R – Rejected.
- [no qualifier] – Detected

The impact of such qualification shall be discussed in the data quality evaluation.

Describe the evaluative procedures used to assess overall measurement error associated with the project.

To assess whether a sufficient quantity of acceptable data are available for decision-making, the data will be reviewed by MEC-experienced data processing geophysicists.

If significant inconsistencies in data are detected, they will be evaluated to assess impact on decision making.

If significant differences between replicates (field duplicates, laboratory replicates) is observed, as defined by precision exceedances described by Worksheet #12 or #28, they will be evaluated to determine the source of the discrepancy, if possible. The greater of results between field duplicates will be considered.

If significant deviations are noted between QC of equipment, background information, and field data, the cause will be further evaluated to assess impact on decision making.

Describe the documentation that will be generated during the usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

Data tables will be produced for geophysical data and will reflect which anomalies were selected as significant and which were eliminated from consideration during data interpretation.

Graphical representations and site representative figures will be produced to reflect the areas that are most likely to contain MEC.

The final report will identify any data usability limitations and recommend additional investigations if necessary.

A data quality evaluation section will be included as part of the final report to summarize the results of the data collection and interpretation. The distribution of data validation qualifiers will be examined to determine if there are patterns, and concentration ranges for nondetect results will be examined to verify that they are appropriate to support decisions made with respect to the project action levels.

The final report will identify any data usability limitations and recommend CA if necessary.

SAP Worksheet #37—Usability Assessment (continued)

Identify the personnel responsible for performing the usability assessment.

The PM, Project Geophysicist, and other team members will be responsible for collecting and compiling the data. The data will then be presented to the Navy, MCIEAST- MCB CAMLEJ, NCDENR, and USEPA, which will evaluate the data usability according to project objectives.

References

Cardinell, A. P., S. A. Berg, and O. B. Lloyd, Jr. (Cardinell et al.). 1993. Water Resources Investigations Report 93-4049: Hydrogeologic Framework of U.S. Marine Corps Base at Camp Lejeune, North Carolina. U.S. Geological Survey.

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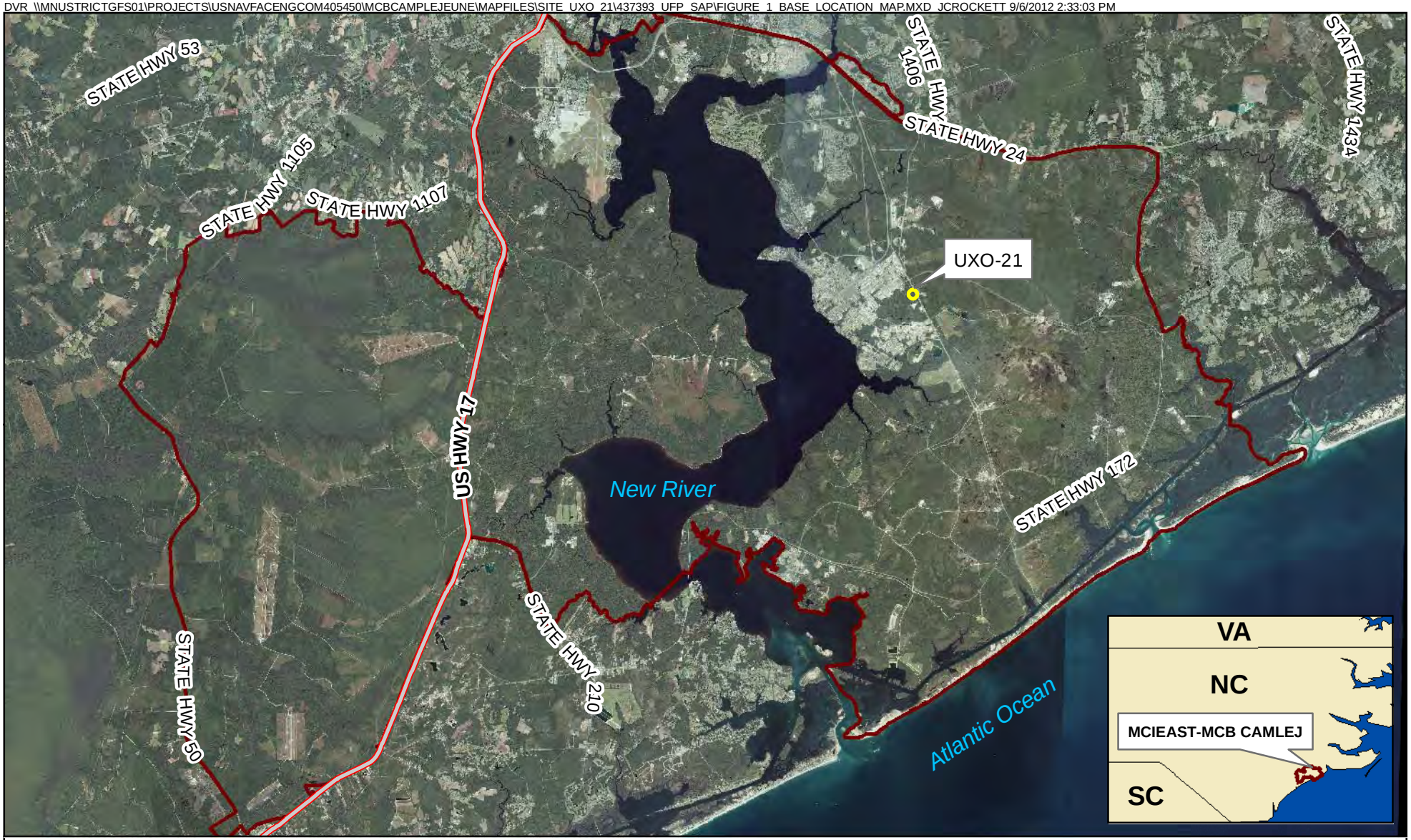
Figures

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\MCBCAMPLEJEUNE\MAPFILES\SITE_UXO_21\437393_UFP_SAP\FIGURE_1_BASE_LOCATION_MAP.MXD JCROCKETT 9/6/2012 2:33:03 PM



Legend

- Highways
- UXO-21 Boundary
- Installation Boundary

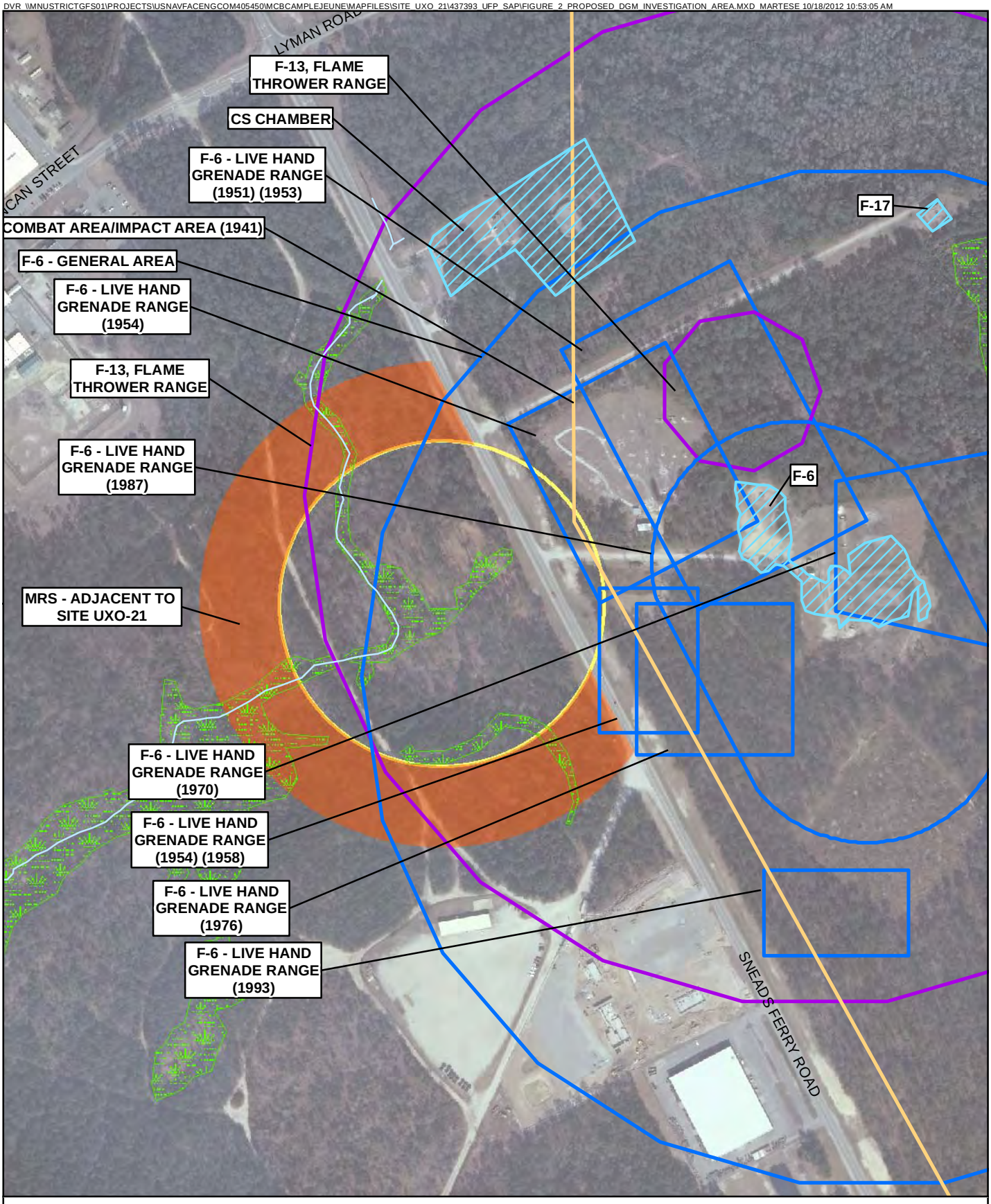
N

0 7,500 15,000 30,000 Feet

1 inch = 15,000 feet

Figure 1
Base Location Map
Site UXO-21
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL



Legend

- Surface Water Course Centerline
- Military Range Area
- Combat Area/Impact Area
- F-6 - Live Hand Grenade Range and General Area
- F-13 - Flame Thrower Range
- Jurisdictional Wetlands
- Investigation Area
- Site UXO-21 Boundary

N

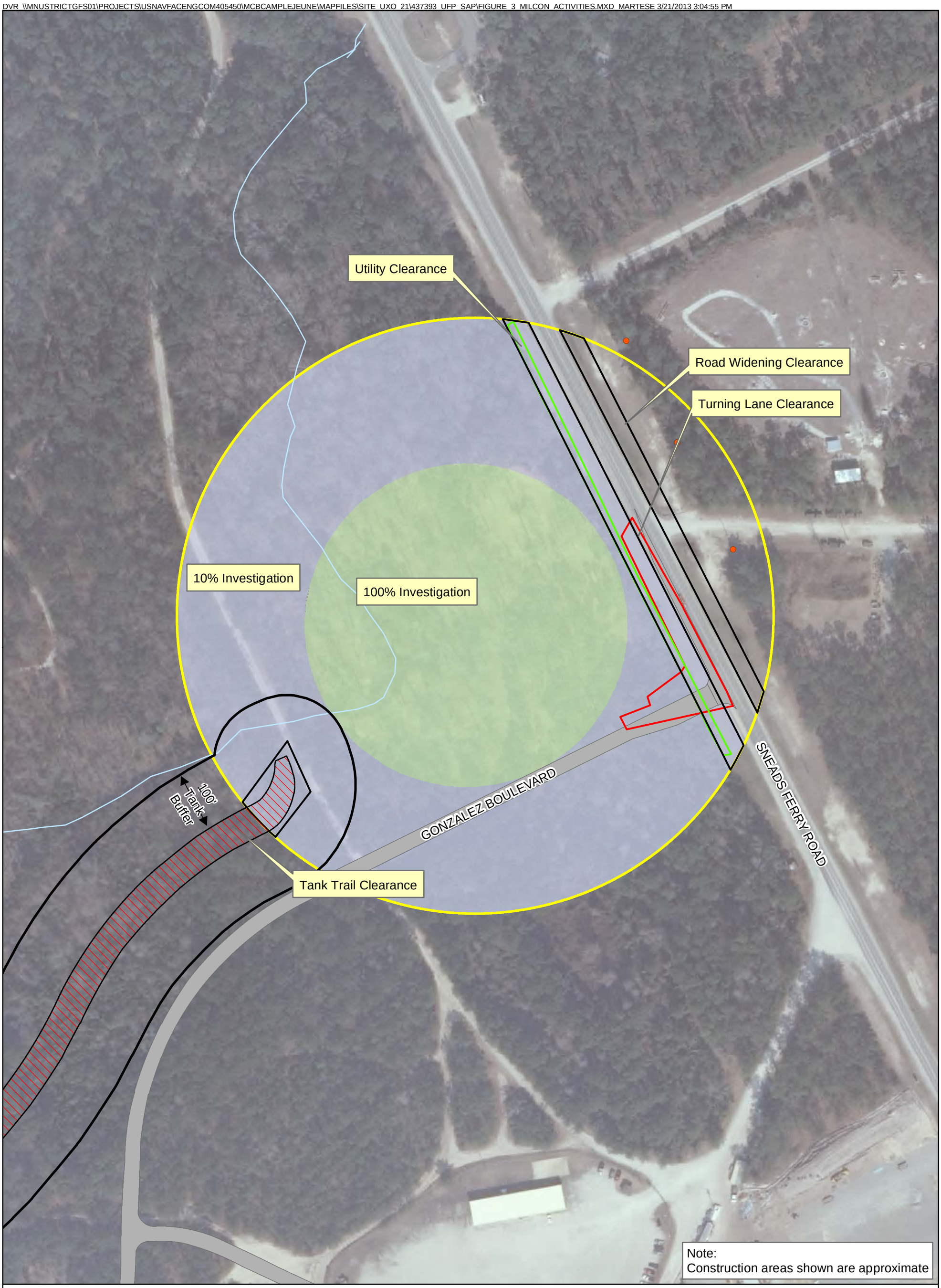
0 200 400 800 Feet

1 inch = 400 feet

Figure 2
Investigation Area
Site UXO-21
MCIEAST - MCB CAMLEJ
North Carolina

CH2MHILL

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\MCBCAMPLEJEUNE\MAPFILES\SITE_UXO_21\437393_UFP_SAP\FIGURE_3_MILCON_ACTIVITIES.MXD MARTESE 3/21/2013 3:04:55 PM



Legend

- Utility Pole Locations
- Surface Water
- DGM Transects
- Site UXO-21 Boundary
- Phase I PA/SI Investigation Area
- Phase II PA/SI Investigation Area
- Estimated Tank Trail
- Turn Lane Clearance
- Utility Clearance
- Road Widening Clearance
- Existing Gonzalez Blvd

N

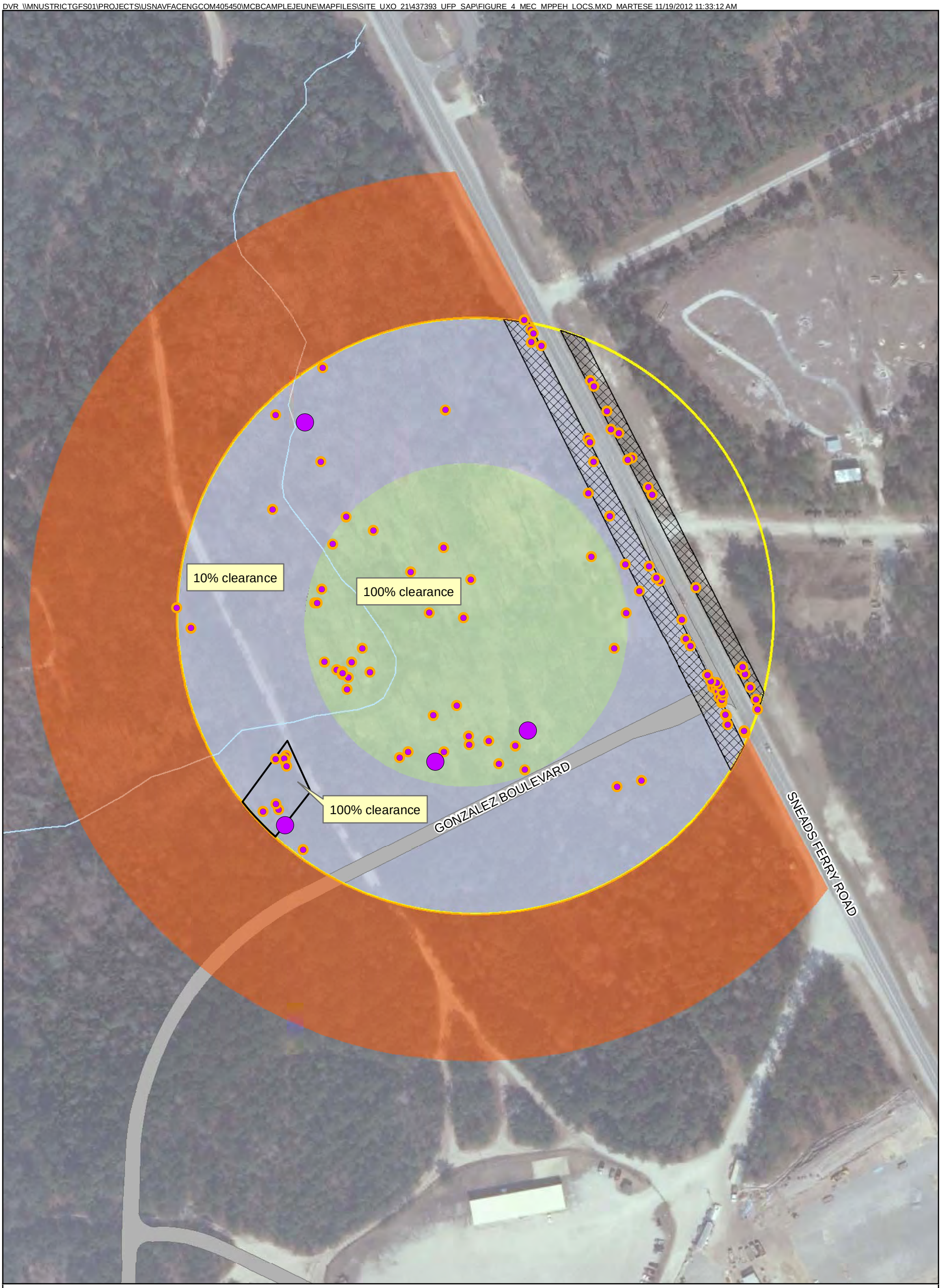
0 75 150 300 Feet

1 inch = 150 feet

Figure 3
MILCON Activities
Site UXO-21
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\MCBCAMPLEJEUNE\MAPFILES\SITE_UXO_21\437393_UFP_SAP\FIGURE_4_MEC_MPPEH_LOCS.MXD MARTESE 11/19/2012 11:33:12 AM



Legend

- Investigated Anomaly-MPPEH
- MEC
- Surface Water
- Tank Trail Clearance Area
- Road Widening Clearance
- Existing Gonzalez Blvd
- Site UXO-21 Boundary
- Phase I PA/SI Investigation Area
- Phase II PA/SI Investigation Area
- Investigation Area

N

0 75 150 300 Feet

1 inch = 150 feet

Figure 4
MEC/MPPEH Locations
Site UXO-21
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\MCBCAMPLEJEUNE\MAPFILES\SITE_UXO_21\437393_UFP_SAP\FIGURE_5_GROUNDWATER_POTENTIOMETRIC_MAP_APRIL_2010.MXD JCROCKETT 9/6/2012 2:14:26 PM

Legend

- Monitoring Well Location
- Estimated Direction of Groundwater Flow
- Potentiometric Groundwater Contour
- Potentiometric Groundwater Contour (inferred)
- Surface Water
- Jurisdictional Wetlands
- Site UXO-21 Boundary

Groundwater elevations are presented for each groundwater monitoring well installed during the PA/SI in ft msl.

N

0 50 100 200 Feet

1 inch = 100 feet

Figure 5
Groundwater Potentiometric Map (April 2010)
Site UXO-21
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

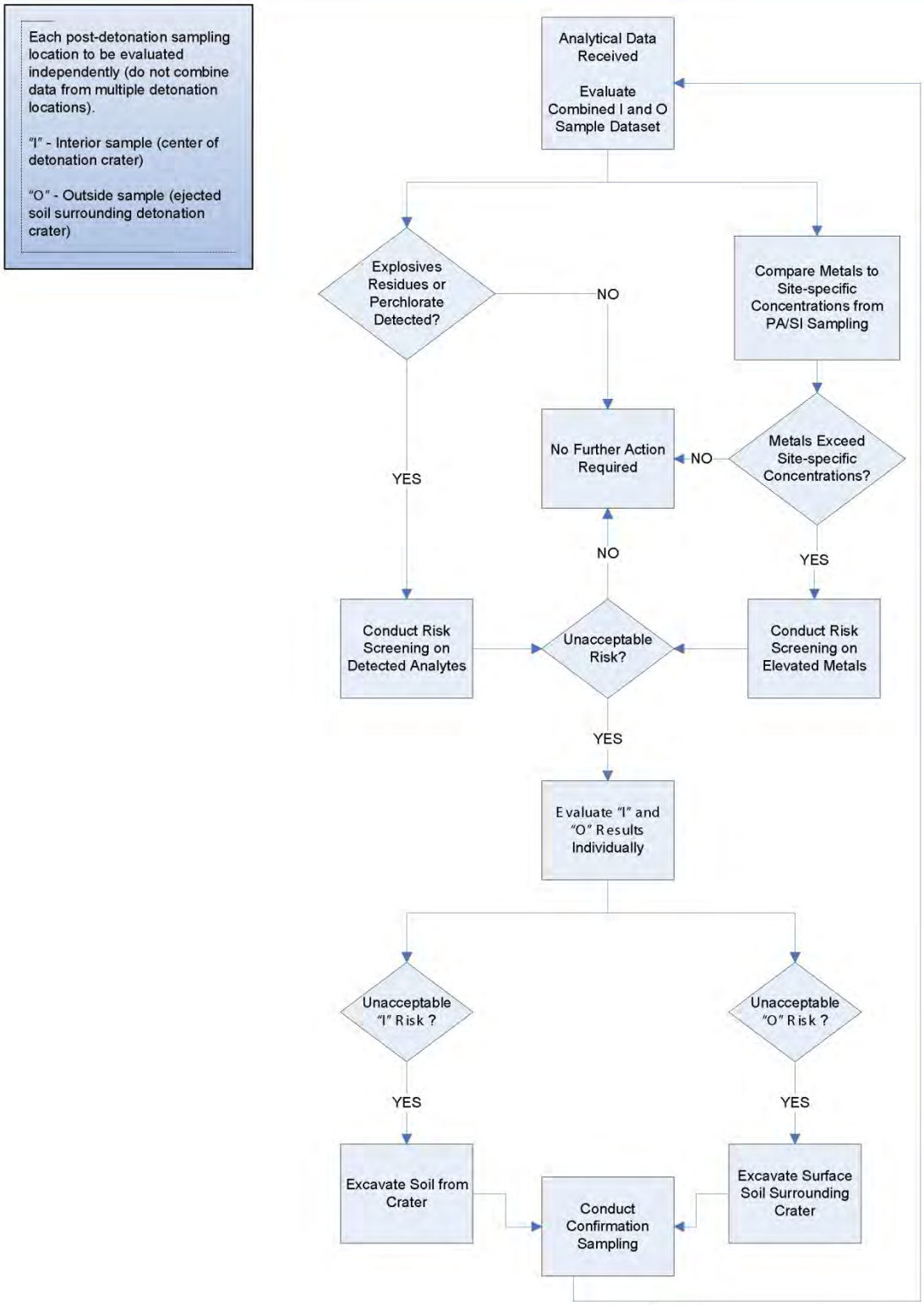


Figure 6
Post Detonation Data Evaluation Process
Site UXO-21
MCIEAST-MCB CAMLEJ
North Carolina

DVR \\MNUSTRICTGFS01\PROJECTS\USNAVFACENGCOM405450\MCBCAMPLEJEUNE\MAPFILES\SITE_UXO_21\437393_UFP_SAP\FIGURE_7_PROPOSED_DGM_TRANSECTS.MXD JCROCKETT 9/14/2012 1:36:39 PM

Legend

- Proposed DGM Transects
- Previous DGM Transects
- Surface Water Course Centerline
- Jurisdictional Wetlands
- Investigation Area
- Site UXO-21 Boundary

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 7
Proposed DGM Transects
Site UXO-21
MCIEAST - MCB CAMLEJ
North Carolina

CH2MHILL

Appendix A
Technical Management Plan

Final

Technical Management Plan for Munitions Response Investigation at Site UXO-21 Former D-Area Gas Chamber 2D MAR DIV (ASR 2.204)

Marine Corps Installation East- Marine Corps Base Camp Lejeune Jacksonville, North Carolina

Task Order WE54

May 2013

Prepared for

Department of the Navy
Naval Facilities Engineering Command

Under the

NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012

Prepared by

Charlotte, North Carolina

Contents

Acronyms and Abbreviations

AHA	Activity Hazard Analysis
bgs	below ground surface
BIP	blow-in-place
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CWM	chemical warfare material
DGM	digital geophysical mapping
DoD	Department of Defense
ESQD	Explosives Safety Quantity Distance
ESS	Explosives Safety Submission
EZ	exclusion zone
FS	Feasibility Study
GIP	Geophysical Investigation Plan
GPS	global positioning system
GSV	Geophysical Systems Verification
HASP	Health and Safety Plan
HEAT	high explosives anti-tank
IDW	investigation-derived waste
IS	incremental sampling
MCIEAST-MCB CAMLEJ	Marine Corps Installations East- Marine Corps Base Camp Lejeune
MDAS	material documented as safe
MEC	munitions and explosives of concern
MGFD	munitions with the greatest fragmentation distance
MMRP	Military Munitions Response Program
MPP	Master Project Plans
MPPEH	material potentially presenting an explosive hazard
MR	munitions response
MRP	Munitions Response Program
MRS	Munitions Response Site
MSD	minimum separation distance
PA/SI	Preliminary Assessment/Site Inspection
PETN	pentaerythritol tetranitrate
QA	quality assurance
QC	quality control
SAP	Sampling and Analysis Plan
SM	Site Manager
SOP	Standard Operating Procedure
SUXOS	Senior UXO Supervisor
TAL	Target Analyte List
UFP	Uniform Federal Policy
UXO	unexploded ordnance
UXOSO	UXO Safety Officer
UXOQCS	UXO QC Specialist

SECTION 1

Introduction

Under the Military Munitions Response Program (MMRP) and pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), Marine Corps Installations East- Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) is in the process of addressing munitions and explosives of concern (MEC) at Site Unexploded Ordnance (UXO) 21. CH2M HILL on behalf of MCIEAST-MCB CAMLEJ has conducted a Preliminary Assessment/Site Inspection (PA/SI) (CH2M HILL, 2011) and a Phase I Expanded Site Investigation (ESI) (CH2M HILL, 2012a) for Site UXO-21. This Technical Management Plan provides the details associated with the field investigation for the Phase II ESI.

1.1 Background and Project Objectives

Geophysical surveys were conducted as part of the PA/SI and the Phase I ESI (CH2M HILL, 2011, 2012a). An intrusive investigation of the anomalies identified within the investigation area was performed. Material potentially presenting an explosive hazard (MPPEH) and munitions and explosives of concern (MEC) were discovered near the site boundary during the Phase I ESI. Therefore, a munitions response site (MRS) adjacent to Site UXO-21 was established to expand the investigation area outside the original boundary for the Phase II ESI.

The purpose of the Phase II ESI is to define the nature and extent of MEC and MPPEH in the MRS Adjacent to UXO-21. DGM and intrusive investigation of anomalies selected as representing potential subsurface MEC will be performed in the investigation area (**Figure 2**). Data from these activities will be combined with data from previous investigations and used to characterize the nature and extent of MEC/MPPEH at Site UXO-21.

1.2 Scope of Work

The following activities will be performed at Site UXO-21 in accordance with methods and procedures detailed in the *MCB CAMLEJ Munitions Response Program Master Project Plans* (MRP MPP) (CH2M HILL, 2008):

- Vegetation clearance and DGM in 10% of the investigation area
- Manual excavation and identification of the sources of 100% of the geophysical anomalies identified from the DGM as representing potential subsurface MEC
- Demolition of all MEC
- Inspection and demilitarization of all MPPEH
- If controlled detonations are performed, two surface soil samples will be collected from those location(s)
- Anomaly removal verification and excavation backfilling
- Transportation of material documented as safe (MDAS) offsite for processing
- Preparation of an After Action Report when it is determined that all munitions response (MR) actions are complete
- Preparation of a Phase II ESI report summarizing the results of the investigation

1.3 Guidance, Regulations, and Policies

The Phase II ESI at Site UXO-21 will be conducted under the guidance documents, regulations, and polices described in Section 2.1 of the MRP MPP (CH2M HILL, 2008).

1.4 Explosives Safety Submission

An Explosives Safety Submission (ESS) will be submitted to Marine Corps Systems Command for approval before activity begins on the Site. The intrusive investigation in the MRS Adjacent to Site UXO-21 will be conducted in

accordance with the ESS for Munitions Response Activities at Munitions Response Site Adjacent to UXO-21 Former D-Area Gas Chamber (ESS-129) (CH2M HILL, 2012b). The ESS will conform to all applicable Marine Corps, Department of the Navy, and Department of Defense (DoD) requirements for the safe handling of MEC and explosives.

1.5 MEC Contingency Procedures

Based on the documented history of DoD activities at Site UXO-21, it is anticipated that if MEC is discovered it can be destroyed onsite. Therefore, alternatives to onsite disposal are not identified in this technical management plan. Likewise, the discovery of MEC that cannot be identified is not anticipated. If MEC items are discovered that cannot be identified, MEC contingency procedures will be followed in accordance with Section 2.2 of the MRP MPP (CH2M HILL, 2008).

1.6 Chemical Warfare Materiel Contingency Procedures

Based on the documented history of DoD activities at Site UXO-21 and previous investigation results, it is not anticipated that chemical warfare materiel (CWM) will be discovered. However, if it is encountered, all work will immediately cease and CWM contingency procedures will be conducted in accordance with Section 2.3 of the MRP MPP (CH2M HILL, 2008).

SECTION 2

Field Investigation Plan

The following subsections describe the procedures associated with site preparation and restoration, DGM investigation, and post-detonation sampling, if conducted. Section 3 describes procedures for the intrusive investigation and MEC/MPPEH management.

2.1 Site Preparation and Restoration

The following activities will be conducted to prepare and restore the investigation area.

2.1.1 Buried Utility Clearance

The North Carolina One-Call Center will be contacted regarding planned intrusive investigation. An insured subsurface utility locator will be subcontracted by CH2M HILL to locate and mark underground utilities at the site. Buried utilities will be identified within a 20-foot radius of transects.

2.1.2 Site Survey

Land surveying services will be conducted in accordance with Section 7.4 of the MRP MPP (CH2M HILL, 2008). The surveying services will be completed under two mobilizations:

- **Phase 1** will delineate the extent of the investigation area and will also mark out the areas that will be subjected to vegetation clearing for the DGM effort.
- **Phase 2** will occur after the vegetation clearing and will consist of the layout of the transects. Approximately 18,649 linear feet of transects (1-meter wide) will be staked in the investigation area.

During all phases of surveying activities, MEC avoidance will be conducted in accordance with the Site Specific Health and Safety Plan (HASP), standard operating procedures (SOP), and activity hazard analyses (AHA) (**Appendix A**). UXO Technicians will escort surveying personnel while onsite and will practice anomaly avoidance at all locations where stakes are driven.

2.1.3 Vegetation Clearing

Vegetation clearance will be conducted to facilitate access for DGM. Vegetation less than 6 inches in diameter will be removed to within 6 inches of the ground surface using a combination of mechanical and manual methods, depending on site conditions. Felled brush and trees will be mulched and left in place. Trees greater than 6 inches in diameter will not be removed unless necessary. Overhanging vines and protruding branches that could interfere with the safe and effective performance of investigation activities will also be removed.

During the vegetation removal process, UXO technicians will conduct MEC avoidance activities in accordance with the HASP, SOP, and AHA (**Appendix A**).

2.1.4 Site Restoration and Demobilization

Site Restoration

Damage caused by equipment or other site activities (such as deep ruts or intrusive investigation) will be repaired, and the site will be re-vegetated as necessary to prevent erosion.

Demobilization

Full demobilization will occur when the project is completed and appropriate quality assurance/quality control (QA/QC) checks have been performed. The following activities will occur prior to demobilization:

- Anomaly source removal verification will be completed
- If post-detonation soil samples are collected, chain-of-custody records will be reviewed to ensure that all field and QC samples were collected as required and were submitted for appropriate analyses
- Verification of adequate site restoration at the site will be completed

- All field equipment will be inspected, packaged, and shipped to the appropriate location

2.2 DGM Investigation

The following subsections summarize the procedures for the DGM investigation and its associated reporting requirements.

2.2.1 Geophysical Investigation Plan

The Geophysical Investigation Plan (GIP) provided in **Appendix C** of the Uniform Federal Policy – Sampling and Analysis Plan (UFP-SAP) provides details of the equipment, approach, methods, operational procedures, and QC to be used in performing the geophysical investigations at Site UXO-21.

2.2.2 Geophysical System Verification Plan

A Geophysical System Verification (GSV) will be performed as part of the process for validating DGM systems to be utilized during the DGM activities. The GSV Plan is provided in **Appendix D** of the UFP-SAP**,** which provides details of the equipment, approach, methods, operational procedures, and QC to be used in performing GSV at Site UXO-21.

2.2.3 Geospatial Information and Electronic Submittals

Methods, equipment, accuracy, and submittal requirements for location surveys and mapping are described in Section 7.4 of the MRP MPP (CH2M HILL, 2008).

2.3 Post-Detonation Soil Sampling Plan

The following subsections outline the field and IDW requirements associated with post-detonation soil sampling.

2.3.1 Field Operations

Sampling will be required if controlled detonation is performed during the investigation activities at Site UXO-21. Explosives residues associated with controlled detonation/BIP operations could impact the surrounding soils. Post-detonation soil samples will be collected at two locations where controlled detonations/BIP operations are conducted. One composite surface soil sample will be collected using the TR-02-1 sampling approach in the resulting crater, and the incremental soil (IS) sampling method (see *Systematic Random Multi-Increment Sampling* SOP in Appendix D) will be utilized to collect one composite sample from outside of the crater. Sampling requirements are summarized briefly in the following sections.

Surface Soil TR-02-1 Sampling

The surface soil sample from the crater will be collected using the TR-02-1 approach (Thiboutot, et al., 2002). Each sampling location will be defined as an area measuring 1 meter × 1 meter. Coordinates of the sampling locations will be based on the center of the sampling area. Soil samples will be collected by compositing a minimum of 30 sample increments from random locations within each 1-meter × 1-meter sampling location. The sample increments will be approximately equal in the amount of soil, which will be collected from depths of 0 to 2 inches below ground surface (bgs). The sample increments at each location will be composited into a single sample following the *Homogenization of Soil and Sediment Samples* SOP in Appendix C of the MRP MPP (CH2M HILL, 2008) prior to being transferred to the appropriate sample containers.

Incremental Soil Sampling

The use of explosives during the MEC intrusive investigation could also impact the soils ejected from the crater. One surface soil samples will be collected outside the crater utilizing the IS method. The decision unit (DU) for the post-detonation sample collected outside the crater (outside the 1-meter × 1-meter TR-02-01 sampling area) will be roughly circular and centered upon the crater, with a radius of up to 15 meters to encompass the visible ejecta pattern. The maximum radius of 15 meters is based on work conducted by the U.S. Army Engineer Research and Development Center entitled “Explosive Residues from Blow-in-Place Detonations of Artillery Munitions“ (Pennington, et al., 2008) that concluded that the majority of the explosives residue mass falls within 15 meters of

the detonation center. At least 30 aliquots of soil will be collected from 0 to 2 inches bgs and homogenized in accordance with the IS SOP in Appendix C of the MRP MPP (CH2M HILL, 2008).

Samples from both inside and outside the detonation crater will be analyzed by a fixed-base laboratory for the following parameters:

- Explosives residues including pentaerythritol tetranitrate (PETN) and nitroglycerin (SW-846 USEPA Method 8330/8332)
- Perchlorate (SW-846 USEPA Method 6850)
- Target Analyte List (TAL) metals including mercury (SW-846 USEPA Methods 6010C and 7471B)

2.3.2 IDW Management

All investigative derived waste (IDW) generated during the investigation will be managed in accordance with the Waste Management Plan (CH2M HILL, 2009).

Once post-detonation areas are sampled, the samples will be used to determine if soil from those areas will require disposal as IDW, as indicated in the Post-Detonation Data Evaluation Process shown in Figure 6 of the UFP-SAP.

SECTION 3

MEC Intrusive Investigation Plan

MEC intrusive investigation will be conducted to evaluate the nature and extent of MEC/MPPEH that may be present at the site. Based on the results of DGM, all anomalies will be reacquired and intrusively investigated.

The primary intrusive investigation activities are:

- Anomaly reacquisition
- Manual excavation
- Anomaly source identification and verification
- MEC/MPPEH demilitarization
- Collection of surface soil samples if controlled detonation/blow-in-place (BIP) occurs on site

The equipment, approach, methods, operational procedures, and QC to be used during the intrusive investigations are detailed as follows.

3.1 MEC Removal Operations

All anomalies representing potential MEC/MPPEH will be reacquired and intrusively investigated.

3.1.1 DGM Transects

Anomaly Reacquisition

All geophysical anomalies identified for excavation will be reacquired by an intrusive investigation team or by registered land surveyor. If the anomaly is not immediately intrusively investigated, the location will be flagged using a PVC flag with the unique identifier number recorded in indelible ink. The location will be flagged 1 foot north of the actual field location of each reacquired anomaly shown on the tracking sheet.

Manual Excavation/Intrusive Investigation

Excavation of individual geophysical anomalies will be performed by qualified UXO technicians using hand-excavation tools to a maximum depth of 2 feet. The UXO teams performing this work will be composed of at least one UXO Technician II and up to four UXO Technicians II or I supervised by a UXO Technician III. Details associated with this operation are included in the MEC Removal Standard Operating Procedure (SOP) **in Appendix E** of the UFP-SAP.

Hand tools will be used for the majority of the items, which generally are expected to be found near the surface. The following basic technique will be used for anomaly excavation:

- The UXO technician will investigate 1 foot south of the emplaced flag with the assistance of a Schonstedt GA-52CX or equivalent, within a 1-meter radius to pinpoint the anomaly source.
- Until identified otherwise, the anomaly is assumed to be MEC. Excavation will be initiated adjacent to the subsurface anomaly. The excavation will continue until the excavated area has reached a depth below the top of the anomaly as determined by frequent inspection with an appropriate geophysical instrument.
- Using progressively smaller and more delicate tools to remove the soil carefully, the excavation team will expand the sidewall to expose the metallic item for inspection and identification without moving or disturbing the item.
- Once the item is exposed for inspection, the excavation team will determine whether the item is MEC, MPPEH, or other debris.

If the item is MEC, a positive identification will be documented and confirmed by another UXO technician. If MEC/MPPEH is determined safe to move (as confirmed by the Senior UXO Supervisor [SUXOS] and UXO Safety

Officer [UXOSO]), the MEC may be moved for controlled detonation and/or consolidation. All other MEC will be BIP.

In determining whether MEC/MPPEH items are safe to move, the SUXOS and UXOSO must determine that the risk associated with movement is acceptable and that the movement is necessary for the efficiency of the activities being conducted or the protection of people, property, or critical assets. In such cases, the responsible SUXOS and UXOSO must agree with the risk determination and document this decision in writing prior to movement of the MEC. UXO-qualified personnel may determine that MPPEH is safe for onsite movement. Written documentation and concurrence of the UXOSO is not required for MPPEH.

Following demolition/removal of the MEC item, MPPEH, or other debris, the area will be rechecked with an EM61-MK2 to ensure that another item was not hidden beneath the removed item or otherwise remaining within the 2-foot excavation depth. The excavation team will then record the results of the excavation, backfill the hole, and move on to the next marked subsurface anomaly location.

If the item is other debris, it will be collected and segregated away from MPPEH.

If the item is MPPEH, the procedures presented in **Section 3.3** will be followed.

3.2 Removal Verification

Upon completion of the intrusive investigation of all anomalies within a transect or group of transects completed by DGM, the UXOQCS shall perform a QC check on all targets. The project geophysicist or the site manager will provide the UXO QC Specialist (UXOQCS) with a list of all the targets that will be verified through QC. The UXOQCS shall inspect each target using an EM61-MK2 (the same type of geophysical device used for DGM). The UXOQCS shall use the EM61-MK2 to observe the strength of the geophysical response at the coordinates of the target and, if the location was cleared to background levels established for the site. If the strength of the geophysical response is appropriate for the site background then the QC inspection for that location is complete. If the geophysical response is greater than background, then the UXOQCS shall inspect a one-meter radius around the target coordinates using an EM61-MK2, and if needed a handheld metals detector (Schonstedt GA-52Cx or equivalent). Hand digging will be conducted at all locations where the presence of buried metals is indicated. The UXOQCS shall record the results of all items that are recovered during the QC inspection. If any pieces of metal 1-inch square are recovered, that will be considered a QC failure of the transect and a Root-Cause Analysis will be initiated. The dig team shall re-investigate all targets within a transect or group of transects where a QC failure has occurred and the QC process will be repeated for the transect or group of transects.

3.3 Procedures for Reporting and Disposition of MEC and MPPEH Items

This section discusses the procedures for reporting and disposing of MEC and MPPEH items encountered during the project, including the responsibilities of personnel, overall safety precautions, data reporting, transportation, safe holding areas, operations in populated areas, demolition operations, and required engineering controls and Exclusion Zones (EZs) for intrusive operations and intentional detonations. The general responsibilities of project personnel are described in Section 2.5 of the MRP MPP (CH2M HILL, 2008).

3.3.1 Overall Safety Precautions

The overall safety precautions described in Section 2.5.1 of the MRP MPP (CH2M HILL, 2008) will be adhered to during the intrusive investigation.

Qualified UXO personnel will dispose of all MEC items (including MPPEH if necessary) using explosive demolition procedures by countercharging these items with an explosive donor charge and detonating the donor charge. This will be performed by a demolition team consisting of one UXO Technician III as the Demolition Supervisor and two UXO Technician II personnel, with the SUXOS responsible for the operation.

3.3.2 Data Reporting

Data reporting for each geophysical anomaly will be done in accordance with Section 2.5.2 of the MRP MPP (CH2M HILL, 2008).

3.3.3 Operations in Populated and Sensitive Areas

There are populated areas surrounding the site that could be impacted by intrusive operations. If the unintentional detonation minimum separation distance (MSD) for public and non-essential personnel during MEC intrusive operations impacts roadways, the Site Manager (SM) will coordinate with Base operations to implement traffic controls. Such controls may include temporarily closing roads or interrupting intrusive operations when vehicular and pedestrian traffic is present.

The EZ for intentional detonation will be determined for each detonation operation. If an inhabited building is impacted, the demolition team will attempt to mitigate this impact through the use of engineering controls. If engineering controls do not adequately reduce the EZ, the SM will coordinate with Base operations to evacuate the inhabited buildings. If possible, demolition operations will be performed after regular building occupation hours.

No threatened and endangered species or their habitats are known to be present within the site boundaries.

3.3.4 Exclusion Zones and Separation Distance

MR activities within the MRS Adjacent to UXO-21 are covered by the Site UXO-21 ESS (ESS-129) (CH2M HILL, 2012b). If any discrepancies exist between this TMP and the ESS, the ESS shall govern.

MRS Adjacent to UXO-21

During previous investigation of Site UXO-21, the primary munitions with the greatest fragmentation distance (MGFD) for the site had been exceeded and the contingency MGFD, the 3.5-inch Rocket, high explosives anti-tank (HEAT), has been implemented for intrusive investigation activities. Explosives Safety Quantity Distance (ESQD) arcs for the contingency MGFD for Site UXO-21 are a shown on **Figure B-1** of the ESS (CH2M HILL, 2012b). EZs for the implemented contingency MGFD are provided on **Table 3-2** of the ESS (CH2M HILL, 2012b).

3.3.5 MEC and MPPEH Hazards Classification, Storage, and Transportation

MEC and MPPEH will be classified and transported as discussed in Section 2.6 of the MRP MPP (CH2M HILL, 2008a). MEC will not be stored. MPPEH will be stored at the MPPEH Collection Point specified in the applicable ESS and stored as discussed in Section 2.6 of the MRP MPP (CH2M HILL, 2008). All MEC/MPPEH will be classified as class/division 1.1. MEC and MPPEH will not be transported offsite.

A systematic approach will be used for collecting, inspecting, and segregating site debris. The approach is designed so that materials undergo a continual evaluation/inspection process from the time they are acquired until the time they are removed from the site. Segregation procedures begin at the time the item is discovered by the UXO Technician. At this point, the UXO Technician makes a preliminary determination as to the classification of the item into one of three categories, and the UXO Technician III confirms the item to be MEC, MPPEH, or other debris.

MPPEH that has undergone two 100 percent visual inspections by two UXO Technician IIIs who are independent of each other in the reporting chain and are authorized to sign the Requisition System Document DD Form 1348-1A as not presenting an explosive hazard is considered to be MDAS. MDAS will be stored in a locked container at least 50 feet from the MPPEH collection point. MDAS and other debris may be transported offsite via a DD Form 1348-1A.

3.3.6 MEC Disposition

MEC and MPPEH will be demilitarized by BIP methods or may be relocated for demolition if the items are determined safe for movement by the SUXOS and UXOSO.

3.3.7 MPPEH Disposition

MPPEH will be visually inspected and independently re-inspected for explosive hazards as discussed in Section 2.7.2 of the MRP MPP (CH2M HILL, 2008). MPPEH that cannot be classified as MDAS will be disposed of in the same manner as MEC.

3.3.8 Recording, Reporting, and Implementation of Lessons Learned during the Project

Lessons learned will be performed in accordance with Section 2.7 of the MRP MPP (CH2M HILL, 2008).

3.4 Demobilization

Full demobilization will occur when the project is completed and appropriate QA/QC checks have been performed. Personnel who are no longer needed during the course of field operations may be demobilized prior to the final project completion date. The following will occur prior to demobilization:

- All areas to be investigated will be verified as completed.
- Restoration of the site to an appropriate condition will be verified.
- All equipment will be inspected, packaged, and shipped to the appropriate location.
- All facilities-support infrastructures will be dismantled and shipped to the appropriate location, and the field site will be returned to the original condition prior to mobilization.

SECTION 4

Explosives Management Plan

The management of on-call explosives to support disposal of MEC and MPPEH items that may be discovered during the investigation at Site UXO-21 will be done in accordance with Section 3 of the MRP MPP (CH2M HILL, 2008).

SECTION 5

Explosives Siting Plan

Explosives safety criteria for planning and siting explosives operations for MEC/MPPEH disposal at Site UXO-21 are provided in Section 4 of the MRP MPP (CH2M HILL, 20008). There are no planned or established MEC detonation areas. MEC that is safe to move may be consolidated for demolition (in accordance with the applicable ESS), otherwise MEC will be BIP where it is found. MPPEH that cannot be certified and verified as "safe to move" will remain at location of discovery and will be treated in the same manner as MEC.

SECTION 6

Environmental Protection Plan

6.1 Regional Ecological Summary

A summary of the regional ecology is provided in Section 9.1 of the MRP MPP (CH2M HILL, 2008).

6.2 Endangered/Threatened Species within the Project Site

Many protected species are known to occur on and adjacent to MCIEAST - MCB CAMLEJ, species such as the American alligator, the green sea turtle, the loggerhead sea turtle, the piping plover, the red-cockaded woodpecker, the bald eagle, the seabeach amaranth, and the rough-leaf loosestrife (USMC, 2006). **Table 6-1** lists those species that could occur in or adjacent to MCIEAST - MCB CAMLEJ that are listed as threatened, endangered, or of special concern by the United States Fish and Wildlife Service (USFWS) under the Endangered Species Act of 1973, as amended.

MCIEAST - MCB CAMLEJ has active programs in place to protect the three federally-protected avian species (American bald eagle, piping plover, and red cockaded woodpecker) that are known to occur on the base. MCIEAST - MCB CAMLEJ worked with the USFWS to establish guidelines for military training in red-cockaded woodpecker cluster sites. Additionally, through Section 7 consultation, the Base implemented measures to properly manage the red-cockaded woodpecker habitats located on base (loblolly pine *[Pinus taeda]* and longleaf *[Pinus palustris]* and pond pine *[Pinus serotina]* areas). These guidelines and measures are presented in the 2007-2011 Integrated Natural Resources Management Plan (INRMP) (USMC, 2006). MCIEAST - MCB CAMLEJ's red-cockaded woodpecker population has been continually monitored since 1985. Reproductive success, population demographics, and habitat use are recorded annually to help successfully manage the population while facilitating the military use of the land. Site UXO-21 is not near any of the known occurrences of these species.

A bald eagle nest is documented on MCIEAST - MCB CAMLEJ at the junction of Sneads Creek and the New River. At its closest point from Site UXO-21, it is approximately 6.8 miles away. Three protective buffers that restrict ground and air-use activities have been established at approximately 750 feet, 1,000 feet, and 1,500 feet from the nest site. Site UXO-21 is not within any of these buffer zones. Non-nesting eagles may use the sites for foraging habitat. However, the proposed work is not expected to impact any special habitat where eagles would concentrate.

The Atlantic Coast populations of piping plovers tend to prefer sandy beaches close to the primary dunes of barrier islands and coastlines. They prefer sparsely vegetated open sand, gravel, or cobble for nesting sites and forage along the rack line where the tide washes up onto the beach. Site UXO-21 does not contain suitable habitat for the piping plover, and therefore piping plovers are not expected to be present (feeding, breeding, and nesting, for example) at the site.

The eastern cougar is the only federally listed mammal species that could occur in Onslow County. The only extant population of eastern cougar is located in south Florida and the species has not been observed in North Carolina in over 50 years.

Two of the four federally listed plant species known from the vicinity have been identified on the base: rough-leaved loosestrife and seabeach amaranth. Approximately 22 rough-leaved loosestrife sites are found on MCIEAST - MCB CAMLEJ with 76 acres buffered and marked to protect this species. Rough-leaved loosestrife sites are visited annually to visually inspect for changes in extent and apparent health. Approximately half of the rough-leaved loosestrife sites occur within protected red-cockaded woodpecker sites, obviating the need for marking each of these sites individually. The other sites, mostly falling within the Greater Sandy Run Area, are marked with white paint around a perimeter that extends 100 feet from the outermost individuals. Site UXO-21 is not located within rough leaved loosestrife sites.

Seabeach amaranth is an annual that has been described as a dune-builder because it frequently occupies areas seaward of primary dunes often growing closer to the high tide line than any other coastal plant. As such, this plant is generally found along Onslow Beach and thus is not located on or adjacent to the site.

Environmental reviews completed in preparation for the INRMP determined that the remaining species listed in **Table 6-2** are not expected to exist at the site. No adverse effects to listed species are expected to result from the proposed work at the site. Project design features have been developed to prevent effects on listed species.

A qualitative evaluation of why state listed threatened and endangered species potentially found in Onslow County for terrestrial and aquatic habitats are not expected at the site is provided in **Table 6-2**. The evaluation is based on state-listed species that are not also federally listed species and described above. No state listed species are expected to be found in the area of investigation at the site.

6.3 Wetlands within the Project Site

Jurisdictional wetland areas are known to be located at Site UXO-21 (**Figure 8**). In order to perform DGM and access geophysical anomalies, vegetation removal will be necessary at the site. Work in wetland areas will be avoided to the extent practical. No direct effects on wetlands are expected to result from the proposed project activities. No significant soil disturbance is anticipated from planned site work as described in this WP. No wetlands on or downstream of the site is expected to be affected by the project.

Owing to the size of the area of investigation, the site is below the threshold for requiring storm water pollution prevention plans. In addition, minimal ground disturbance would result from anomaly investigation.

6.4 Cultural and Archaeological Resources within the Project Site

The investigation activities proposed to support this Work Plan involve intrusive activity. The probability that any significant cultural or archeological resources will be impacted by the field investigation is low. Consultation with the Base archaeologist confirms no cultural or archaeological resources are known to be within the project area. If any unmapped cultural or archaeological materials or resources are discovered within the project area, the Base archaeologist will be notified to provide guidance on performing further work in the area.

6.5 Water Resources within the Project Site

No water resources are expected to be impacted by the project. Site UXO-21 encompasses one surface water source, a channel/stream occurring within the wetland area of the site.

There is adequate vegetative buffer surrounding the site to protect surface water from additional runoff. Because minimal ground disturbance would result from a DGM investigation and anomaly investigation, no storm water pollution prevention plan would be required.

6.6 Coastal Zones within the Project Site

Onslow County is subject to the rules and policies of the North Carolina Coastal Resources Commission, which administers the Coastal Area Management Act (CAMA). The CAMA requires permits for development in Areas of Environmental Concern (AECs) if the area meets all of the following conditions:

- It is in one of the 20 counties covered by CAMA
- It is considered "development" under CAMA
- It is in, or it affects, an AEC established by the Coastal Resources Commission
- It doesn't qualify for an exemption

“Development” includes activities such as dredging or filling coastal wetlands or waters, and construction of marinas, piers, docks, bulkheads, oceanfront structures, and roads.

The intrusive investigation activities at the site will include excavation of target anomalies. These activities do not fit the definition of “development” under CAMA; therefore, a CAMA permit is not necessary for this project.

6.7 Vegetation to be Removed within the Project Site

Limited vegetation removal may be performed at the site to access DGM transects and geophysical anomalies. Only vegetation less than 6-inches in diameter will be cut to within approximately 6 inches of ground surface. Consultation with the Base wildlife biologist confirms no threatened or endangered species have been located within the project area.

6.8 Existing Waste Disposal Sites within the Project Site

No waste disposal sites are present at the site.

6.9 Compliance with Applicable or Relevant and Appropriate Requirements

CH2M HILL will follow all applicable regulations concerning environmental protection, pollution control, and abatement for the proposed project work as described in Section 9.3 of the MRP MPP (CH2M HILL, 2008a). No permits have been determined to be required for the proposed work.

6.10 Detailed Procedures and Methods to Protect and/or Mitigate the Resource/Site Identified

During the proposed work, a general survey of the project area will be conducted by the field personnel to identify obvious environmental concerns. The PM, in conjunction with a qualified ecologist, will provide instructions to field personnel regarding the protection of onsite environmental resources. Such protective measures will include, but are not limited to, the following:

- Should federally-protected plants be identified within the project area, the specimens will be flagged for easy relocation and verification.
- Should cultural or archaeological materials or resources be discovered within a project area, a qualified archaeologist will be notified to provide guidance on performing further work in the area.
- Should the performed work activities impact an environmental resource, the PM will seek the guidance of the qualified ecologist to determine appropriate mitigation measures.

SECTION 7

References

CH2M HILL. 2012a. Expanded Site Investigation Report MMRP Site UXO-21 Former D-Area Gas Chamber (2D MAR DIV) (ASR#2.204) Marine Corps Base Camp Lejeune, Jacksonville, North Carolina. February.

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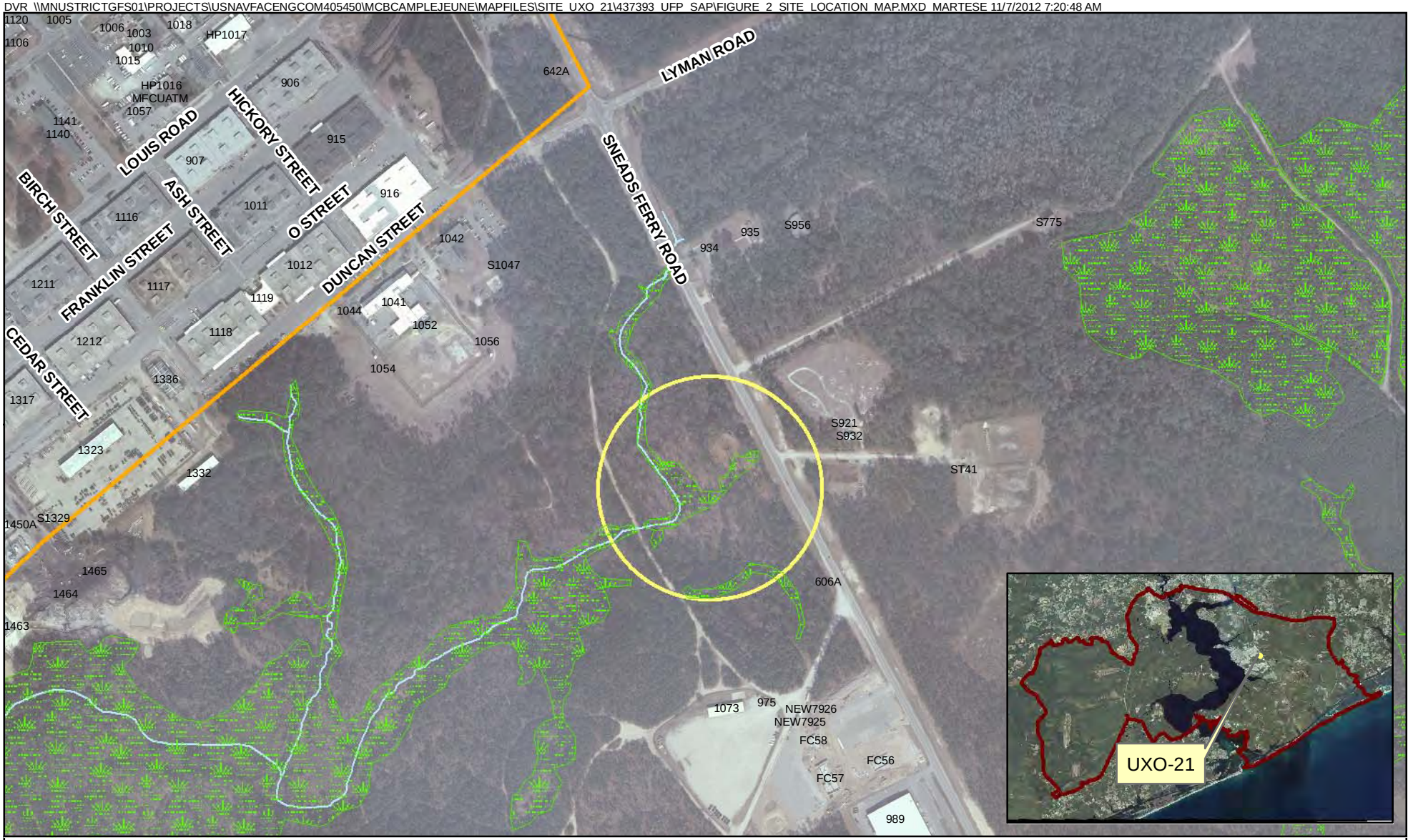

Legend

- Surface Water
- Jurisdictional Wetlands
- Hadnot Point Boundary
- Site UXO-21 - Former D Area Gas Chamber (2D MAR DIV) (ASR #2.204)
- Installation Boundary

N

0 300 600 1,200 Feet

1 inch = 600 feet

Figure 8
Site UXO-21 Jurisdictional Wetlands
Technical Management Plan
MCIEAST-MCB CAMLEJ
North Carolina

CH2MHILL

Appendix B
Geophysical Investigation Plan

Final

Geophysical Investigation Plan
UXO-21 – Former D-Area Tear Gas Chamber

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order WE54

May 2013

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

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Contents

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Acronyms and Abbreviations

2D MAR DIV	2nd Marine Division
ASCII	American Standard Code for Information Interchange
cm	Centimeter
CTO	Contract Task Order
DGM	Digital Geophysical Mapping
DMM	Discarded Military Munitions
ESI	Expanded Site Investigation
ESS	Explosives Safety Submission
ft	Feet
FTP	File Transfer Protocol
GDB	Geosoft Database
GIP	Geophysical Investigation Plan
GPS	Global Positioning System
GSV	Geophysical System Verification
in	Inch
ISO	Industry Standard Object
IVS	Instrument Verification Strip
m	Meter
MCIEAST-MCBCAMLEJ	Marine Corps Base Camp Lejeune
MEC	Munitions and Explosives of Concern
MILCON	Military construction
MPPEH	Material Potentially Presenting an Explosive Hazard
MQO	Measurement Quality Objective
MRSIMS	Munitions Response Site Information Management System
msl	Mean Sea Level
mV	MilliVolt
NAD83	North American Datum 1983
NAVFAC	Naval Facilities Engineering Command
NRL	Naval Research Laboratory
PA/SI	Preliminary Assessment/Site Inspection
PDF	Portable Document Format
PLS	Professional Land Surveyor
QA	Quality Assurance
QC	Quality Control
UTM	Universal Transverse Mercator
UXO	Unexploded Ordnance

SECTION 1

Project Objective

This Geophysical Investigation Plan (GIP) presents the objectives, site background, approach, geophysical operational procedures and quality control (QC) methods to be used to prepare for and perform digital geophysical mapping (DGM) at Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) in Jacksonville, North Carolina. DGM will be performed at Munitions Response Site (MRS) UXO-21 – Former D-Area Gas Chamber, 2nd Marine Division (2D MAR DIV).

This GIP was prepared on behalf of the Department of the Navy, Naval Facilities Engineering Command (NAVFAC) Washington, under Contract Number N62470-11-D-8012, Contract Task Order (CTO) WE54.

The DGM will be conducted in support of a Phase II Expanded Site Investigation (ESI). The objective of the Phase II ESI is to characterize the nature and extent of potential Munitions and Explosives of Concern (MEC) and Material Potentially Presenting an Explosive Hazard (MPPEH). DGM will be conducted to identify geophysical anomalies that may be indicative of potential MEC and MPPEH.

SECTION 2

Site Description

The UXO-21 MRS encompasses approximately 17 acres, located along Sneads Ferry Road, south of Lyman Street and southeast of the Hadnot Point area of MCIEAST-MCB CAMLEJ. The site was reportedly used as a gas chamber in 1970. Based on the operational history of the site, chemical warfare training agents (tear gas) would have been used for gas mask confidence drills. Other chemical training items, including war gas identification sets and riot control hand grenades, may have been used in the area surrounding the gas chamber.

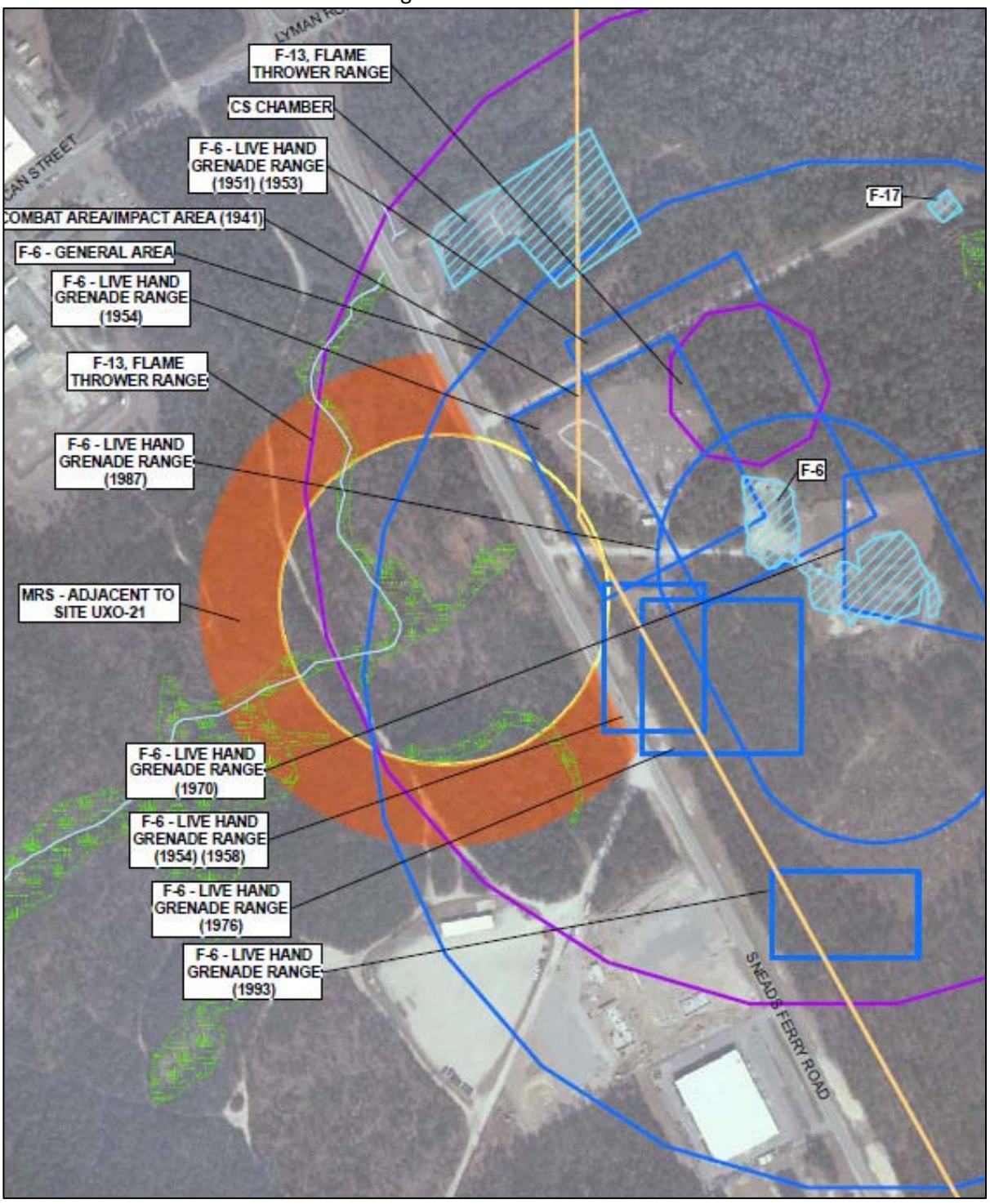
Previous investigations at UXO-21 by CH2M HILL include a Preliminary Assessment/Site Inspection (PA/SI) conducted between 2007 and 2010 (CH2M HILL, 2011), a Phase I ESI in 2011 (CH2M HILL, 2012a) and military construction activities in support of improvements along Sneads Ferry Road and existing tank trails in 2012. DGM was conducted as part of the PA/SI in two phases and intrusive investigations conducted on the anomalies identified in the Phase I PA/SI results. The Phase I ESI was conducted to identify the nature of the additional geophysical anomalies identified during the Phase II PA/SI DGM. DGM and intrusive investigations were conducted as part of the 2012 military construction activities.

For the ESI, an additional MRS has been established adjacent to the original UXO-21 MRS. UXO-21 has an approved Explosives Safety Submission (ESS) in place and is a designated MRS. It was decided by the Partnering Team that, for the ESI, an additional MRS would be added and new ESS would be generated for this additional MRS as opposed to changing the original MRS boundary for UXO-21. The additional MRS (and DGM investigation area) is depicted in the orange hatch pattern in **Figure 1** and comprises approximately 14 acres. The original UXO-21 MRS is represented by the yellow circle in **Figure 1**.

MEC and MPPEH items identified during the previous investigations at UXO-21 were inconsistent with the documented history of the site as a former tear gas chamber and suggest previously unidentified range activities may have been conducted at or overlapped with UXO-21. The MEC and MPPEH items identified during the previous investigations at UXO-21 are presented in **Figure 2**.

FIGURE 1
UXO-21 Original MRS and Additional MRS

FIGURE 2
UXO-21 Previous MEC and MPPEH Findings



Although the documented history of UXO-21 is a former gas chamber area, the site does lie within a portion of overlapping ranges that include a historic flame thrower range, general use combat/impact area and historic live hand grenade ranges (**Figure 2**).

The aereal extent of the additional MRS at UXO-21 was based on the recommendations of the Phase I ESI, specifically the isolated occurrences of MEC and MPPEH within approximately 100 feet of the western, northwestern and southwestern boundaries of the original UXO-21 MRS boundary (**Figure 2**).

SECTION 3

Anticipated MEC Types and Quantities

Information on the types of MEC and MPPEH that may be present at the MRS can be found primarily in the *Explosives Safety Submission, Munitions Response Activities at Munitions Response Site Adjacent to UXO-21, Former D-Area Gas Chamber (ESS-129)* (CH2M HILL, 2012b).

In general, MEC and MPPEH that may be found at the MRS include munitions components, ammunition packaging, tear gas canisters, and pyrotechnics. Previous investigations in 2009 identifiedMEC items: a Signal Ground M22A1 and a M27A1B1 projectile air burst simulator. Two other MEC items were discovered in 2011: a Signal, Ground, Red Star, Cluster, M52A1 and a rocket motor from either a M28 HEAT or M29 Practice 3.5-inch Rocket and a M27 signal. In June 2012, another M27A1B1 projectile air burst simulator was discovered during military construction (MILCON) activities.

SECTION 4

Vegetation and Topography

The DGM survey area shown in **Figure 1** consists primarily of woodlands. The woodlands include jurisdictional wetlands and surround an unnamed tributary of Cogdels Creek, which is located approximately one-third of a mile south of Site UXO-21.

Existing tank trails bisect the investigation area. Although there is minimal relief across the area, the potential for localized ruts and uneven ground exists. The DGM survey will be conducted along transects. Vegetation, including trees with diameters of 6 inches (in) or less, will be cut to within 6 in of the ground surface and removed from the transects by others prior to the start of DGM.

SECTION 5

Geologic Conditions

Geologic conditions are generally a concern for DGM when the mineral content of rocks and soils is significant enough to produce anomalies consistent with potential MEC. In particular, these conditions are a greater concern when using magnetometers to conduct surface sweeps or to collect DGM data compared to electromagnetic (EM) or other geophysical instruments. It is assumed that geologic conditions at the site will not significantly impact proposed DGM because MCIEAST-MCB CAMLEJ is situated within the Atlantic Coastal Plain physiographic province and because DGM has been successfully completed at UXO-21 and elsewhere within the installation under similar site conditions.

SECTION 6

Shallow Groundwater Conditions

Localized groundwater conditions may present potential access issues or safety hazards if the survey area is prone to standing water during periods of heavy precipitation. In addition, site-specific groundwater conditions (e.g. depth to water table, salinity) may result in variations of geophysical response signatures of potential MEC items compared to predicted or theoretical responses if the items are susceptible to enhanced corrosion or deterioration due to local groundwater fluctuations and conditions. For the additional MRS at UXO-21, these conditions are unlikely to impact proposed DGM and because DGM has been successfully completed at UXO-21 and elsewhere within the installation.

SECTION 7

Adverse Geophysical Conditions

There are no known adverse conditions that would negatively impact DGM operations at UXO-21. However, because vegetation would only be cleared to within 6 in of the ground surface, the terrain along the transects may be uneven. Such conditions may result in increased noise in the DGM data due to instrument bounce as the DGM system is moved along the DGM transects. The DGM subcontractor will make a determination in the field as to how to deploy the system in order to minimize the effects of terrain-induced noise.

SECTION 8

Site Utilities

CH2M HILL will review available underground utility maps from MCIEAST-MCB CAMLEJ to evaluate the presence of potential underground utilities within the proposed DGM area. Because of the proximity of the DGM areas to Sneads Ferry Road, it is assumed that underground service utilities may be present within the general area. Electronic files or maps that can be obtained by CH2M HILL from the installation will be used, to the extent possible, as overlays on the DGM data in order to assist with interpretation of the DGM results. The North Carolina One-Call Center will be contacted regarding planned intrusive investigation and subsurface sampling activities. An insured subsurface utility locator will be subcontracted by CH2M HILL to locate and mark underground utilities at the site. All buried utilities will be identified within a 20-foot radius of transects.

SECTION 9

Man-made Features Potentially Affecting DGM Operations

There are no manmade features within the DGM area that would likely affect the proposed investigation areas other than trash that may be left behind from field maneuvers that are still conducted within the general area.

SECTION 10

Overall Site Accessibility and Impediments

No substantial delays due to abnormally harsh weather conditions are expected to impact the DGM operations, although periods of heavy rain or other localized weather patterns at the time of DGM may result in temporary inaccessible conditions. CH2M HILL will monitor these conditions in the days prior to the DGM start date and will be in regular communication with the DGM field team. Daily assessments of these conditions will also be made during the site safety briefings.

The presence of jurisdictional wetlands may result in localized areas were vegetation clearance is not permitted and where access to DGM field personnel is not possible.

SECTION 11

Potential Worker Hazards

Potential hazards include those associated with conducting field work in humid climates and densely wooded conditions. Additional hazards include military vehicles and tanks that may be using the trails that bisect the general area. These and other specific hazards will be addressed in more detail in the project activity hazard analysis (AHA), health and safety plan (HASP) and during daily site safety briefings.

SECTION 12

Handheld Geophysical Instrument

The primary handheld geophysical instrument to be used during non-DGM operations (e.g. MEC avoidance, placement of QC seeds) will be a White's XLT all-metals detector. The White's XLT all-metals detector is capable of identifying both ferrous and non-ferrous metals and is swept back and forth at a height of a few inches above the ground surface. It will be used at the site to assist with MEC avoidance procedures during burial and placement of QC seed items to identify whether competing anomalies from subsurface metal (ferrous and non-ferrous) are present within 1 m of an intended seed location. Audible tones and a digital display on the instrument indicate the presence of subsurface metal. The Schonstedt GA-52 handheld magnetometer may be used to supplement the White's XLT.

SECTION 13

DGM Instrumentation

DGM will be conducted using the Geonics, Ltd. EM61-MK2. The EM61-MK2 has been presumptively selected based on existing site conditions, findings of the PA/SI and Phase I ESI and successful prior use of the EM61-MK2 at UXO-21 and elsewhere at MCIEAST-MCB CAMLEJ.

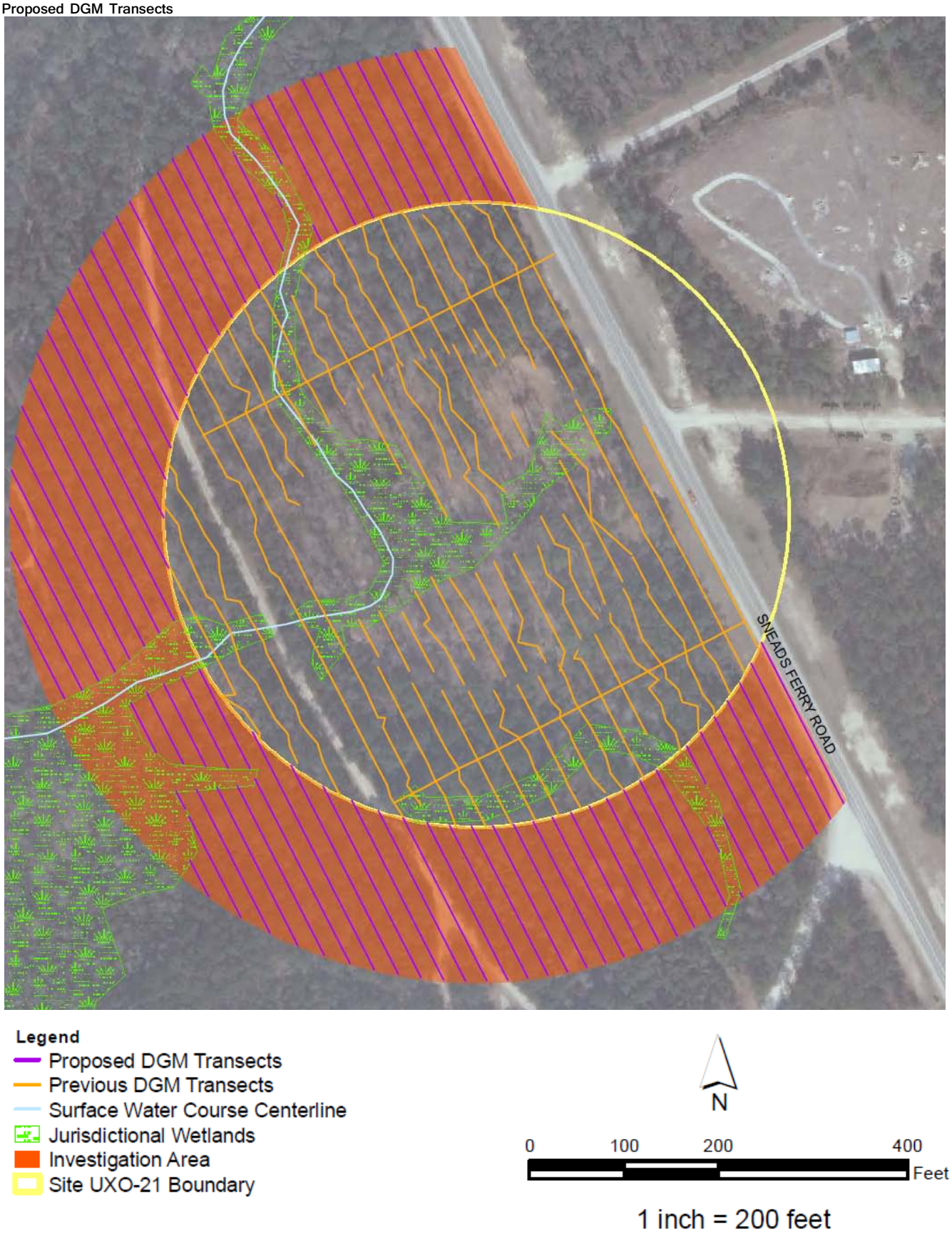
DGM will be performed along individual transects using a single-coil, person-portable EM61-MK2 (**Figure 3**). The footprint width of the single-coil EM61-MK2 (long axis perpendicular to walking direction) is approximately 3.3 ft (1m). DGM will be conducted along transects that comprise approximately 10% coverage of the additional MRS (approximately 1.4 acres). The total length of the DGM transects across the estimated 1.4 acres is approximately 18,587 linear feet (5,665 linear meters).

Location control for the EM61-MK2 data will be performed using fiducial positioning methods. It is assumed that site conditions will not be conducive to the use of a global positioning system (GPS). Fiducial methods use a time-marking procedure to determine the spatial location of the collected data. Using this approach, transects are established over the site to survey-grade accuracy (0.1 ft [3 centimeters [cm]]). Wooden stakes are placed at the beginning and end of each lane and at surveyed positions along each transect (e.g. every 80 ft [25 m]). Transect establishment is performed by a licensed professional land surveyor (PLS) in advance of the DGM.

An operator walks down the lane while the data logger collects sensor readings with each revolution of the wheels if the EM61-MK2 is operated in this mode. As the center of the EM61-MK2 coils pass the starting, fiducial, and end points in the survey lane (i.e. the surveyed wooden stake locations), the operator presses a button on the data logger that places a digital tag in the data file. By assuming the operator walked in a straight line between stakes and at a constant velocity, the location of each data point can be calculated in reference to the known survey stake locations.

The EM61-MK2 survey at UXO-21 will likely be conducted using wheel mode. However, the DGM subcontractor may elect to utilize two-person litter (i.e. tandem) mode collection if ground surface conditions are determined to not be very conducive to the use of the system on its standard wheels. In litter mode, the operator would collect data in automatic collection mode at a rate of 10 readings/second and insert fiducial markers in the data file as the center of the coil passed over a stake location.

FIGURE 3
Proposed DGM Transects



SECTION 14

Geophysical System Verification

DGM system validation will be performed for the EM61-MK2 using the Geophysical System Verification (GSV) process. The GSV is a physics-based presumptively selected technology process in which signal strength and sensor performance are compared to known response curves of industry standard objects (ISOs) to verify DGM systems prior to and during site surveys. The GSV process is designed to perform initial verification of the proposed DGM system using an instrument verification strip (IVS) followed by a blind seeding program for continued verification throughout the field operations. The GSV Work Plan is provided in **Appendix E** provides additional details on the validation process for this site.

SECTION 15

DGM Measurement Quality Objectives

The primary objective of the DGM is to identify geophysical anomalies indicative of potential MEC or MPPEH. Measurement quality objectives (MQOs) particular to the DGM survey are provided in **Table 1**.

TABLE 1
Project Measurement Quality Objectives

MQO	Measurement Performance Criteria	Test Method
General System Function		
DGM System Munitions Detection. DGM system response is within industry standards for detection.	Response to ISO will not vary more than ±20% from known response for specific distance from sensors in static test.	Results of QC Test #4 (Table 3) will be compared to published response curves.
Repeatability. Repeatable and accurate data are being obtained from DGM system.	Response to ISO will not vary more than ±20% from known response for specific distance from sensors in static tests conducted at the beginning and end of each survey day. In addition, response of repeat line is comparable to original line data (qualitative determination).	Results of QC Test #4 (Table 3) will be evaluated quantitatively for compliance. Results of QC Test #5 (Table 3) will be qualitatively compared to results of original survey data.
DGM Surveys		
Data Density. Down line data density is sufficient to detect MEC items.	Over 98% of possible sensor readings are captured along a survey transect with a spacing of no greater than 0.7 ft (0.213 m) between points. A data gap greater than 2 ft (0.61m) will not meet the MQO.	Results of DGM surveys will be quantitatively evaluated for compliance.
Data Positioning. Positioning of detected anomalies is accurate.	Anomaly locations representing QC seeds occur within a 3.3 ft (1m) radius of a point on the ground surface directly above the QC seed.	Anomalies selected will be compared with known (i.e. surveyed) seed item locations for compliance.
Data Handling		
Data must be delivered in a timely manner and in a useable format.	Data packages are completed and delivered to the CH2M HILL Project Geophysicist within schedule (3 days pre-processed; 5 days processed).	Evaluated based on actual delivery of data.

15.1 DGM System Munitions Detection

The MQO for munitions detection is to demonstrate that the EM61-MK2 system is capable of detecting munitions items within industry standards. This capability is demonstrated through a process in which signal strength and sensor performance are compared to validated industry values. For the EM61-MK2, this process involves demonstrating that the maximum amplitude response from an ISO falls within 20% of the predicted, published sensor response for that item (Naval Research Laboratory [NRL], 2009). Once it has been demonstrated that the system responds comparably, a cross correlation of industry experience with detection of munitions items can be assumed. In other words, the depths and orientations of munitions items which the EM61-MK2 has been shown to be effective under test scenarios and other projects can be expected (NRL, 2008).

The spike test results (QC Test #4, **Table 3**) will determine whether the geophysical instrument is responding to within a specific threshold. In this test, the distance from the coil and orientation of the ISO can be strictly controlled in the field.

15.2 Repeatability

The MQO for DGM systems data repeatability is that the systems respond consistently from the beginning to the end of daily operation. For the EM61-MK2, this process involves demonstrating that the maximum amplitude response from an ISO falls within 20% of the predicted, published sensor response for that item at the beginning and end of each survey day.

In addition, as part of this MQO, repeat data profiles will also be collected and qualitatively compared to the original line data. This evaluation is a qualitative evaluation due to potentially slight variations in path traveled during survey line data and repeat line collection.

Repeatability will be evaluated by ensuring that, on a daily basis, the geophysical system being used passes QC Tests #4 and #5 in **Table 3**.

15.3 Data Density

The MQO for down line (along the survey transect) data density is to have sufficient data collected along each transect to detect MEC items and to minimize potential data gaps. The measurement performance criteria are that at 98% or more of possible sensor readings are captured along each transect at distances of 0.7 ft (0.213 m) or less and that no individual data gaps greater than 2 ft (0.61 m) exist along a survey transect, unless the gap is associated with a surface obstruction. This spacing will be quantitatively evaluated in order to determine whether the DGM survey data used for anomaly selection meet this requirement.

15.4 Data Positioning

The MQO for data positioning accuracy is that positioning of detected anomalies is accurate enough to allow for effective reacquisition of the anomaly. The measurement performance criterion for this is that 100% of anomaly locations representing QC seeds are within a 3.3 ft (1 m) radius of a point on the ground surface directly above the source of the anomaly associated with the seed item. An anomaly that is selected outside this radius will not be considered to be a successful detection of that item, unless the reasons for this occurrence can otherwise be explained.

15.5 Data Handling

The MQO for data handling is that pre-processed and final processed data must be delivered in a timely manner and in a useable format. During production surveys, the measurement performance criterion for data handling will require that “draft” (raw) data packages be completed and delivered to the CH2M HILL Project Geophysicist within 3 working days of data collection and the final data packages within 5 working days of data collection. Compliance will be evaluated based on the actual delivery of data.

SECTION 16

Data Acquisition, Processing and Reporting

16.1 Field Data Sheets

Field information will be logged and recorded in the Munitions Response Site Information Management System (MRSIMS). Field devices will be set up for use with MRSIMS and will include the following data entry fields:

- Site ID
- Survey Area ID (e.g. grid, grid block, transects, etc.)
- Field team leader name
- Field team members' names
- Date of data collection
- Geophysical instrument used
- Positioning method used
- Instrument serial numbers
- Geophysical data file names
- Data collection rate (if applicable)
- Line numbers (including survey direction, fiducial locations, start and end points, if applicable)
- Weather conditions
- Terrain conditions
- Cultural conditions
- Survey area sketch
- Associated QC data file names
- Miscellaneous field notes

16.2 Data Processing

Instrument-specific software will be used for initial data processing, and the output will be imported into Geosoft Oasis Montaj™ (Geosoft) for additional processing, graphical display, anomaly selection and QC evaluation. Types of processing will be system specific, but the general processing steps include, but may not be limited to, the following:

- Positional offset correction
- Sensor bias, background leveling and/or standardization adjustment
- Sensor drift removal
- Latency or lag correction
- Geophysical noise identification and removal (spatial, temporal, motional, terrain induced)
- Contour level selection with background shading
- Digital filtering and enhancement (low pass, high pass, band pass, convolution, correlation, non-linear, etc.)

16.3 Interpretation and Anomaly Selection

The data processor will use the following criteria, supplemented by site- and system-specific criteria established during instrument validation, for selecting geophysical anomalies that appear to be indicative of potential MEC or MPPEH:

- Maximum amplitude of the response with respect to local background conditions
- Decay curve characteristics
- Location of the response with respect to inaccessible areas, land features, cultural features, or utilities that bisect the transects

- Potential distortions in the response due to interference from manmade features that may be identified at the site during the DGM survey

16.4 Anomaly Locations

The data analysis process culminates in the creation of anomaly lists in MRSIMS format, an example of which is shown as **Figure 4**. These lists can be opened using Microsoft Excel or standard text editors and include, at a minimum, the following information:

- Unique anomaly identifiers
- Survey area identifier
- Predicted location in Universal Transverse Mercator (UTM), North American Datum 1983 (NAD83) coordinates, in Easting (meters) and Northing (meters)
- Coordinates in site-specific UTM zone
- Anomaly type identifier (e.g. cultural debris, suspected utility, saturated response area, etc.)
- Response amplitude
- Unit of response (e.g. milliVolt [mV])

FIGURE 4
Example MRSIMS Anomaly List for EM61-MK2 Transect Data

ID	GRIDCELLID	X1	Y1	X2	Y2	X3	Y3	X4	Y4	TYPE	AMPLITUDE	UNITS
1	AA-00001	273474.60	3838895.60	0	0	0	0	0	0	1	20.20	mv
2	AA-00002	273473.80	3838893.20	0	0	0	0	0	0	1	8.04	mv
3	AA-00003	273471.00	3838886.00	0	0	0	0	0	0	1	8.85	mv
4	AA-00004	273469.00	3838881.60	0	0	0	0	0	0	1	11.85	mv
5	AA-00005	273462.60	3838867.60	0	0	0	0	0	0	1	27.94	mv

16.5 Anomaly Maps

DGM deliverables will include anomaly maps that contain, at a minimum, the following information:

- Client name
- Project name
- DGM Subcontractor
- Map creator
- Map approver
- Date of map creation
- Map file name (full path and file extension)
- Map scale
- Survey area identification
- Contoured data with color scale
- Anomaly locations with unique identification numbers that match anomaly lists
- North arrow, legend, title block, etc.

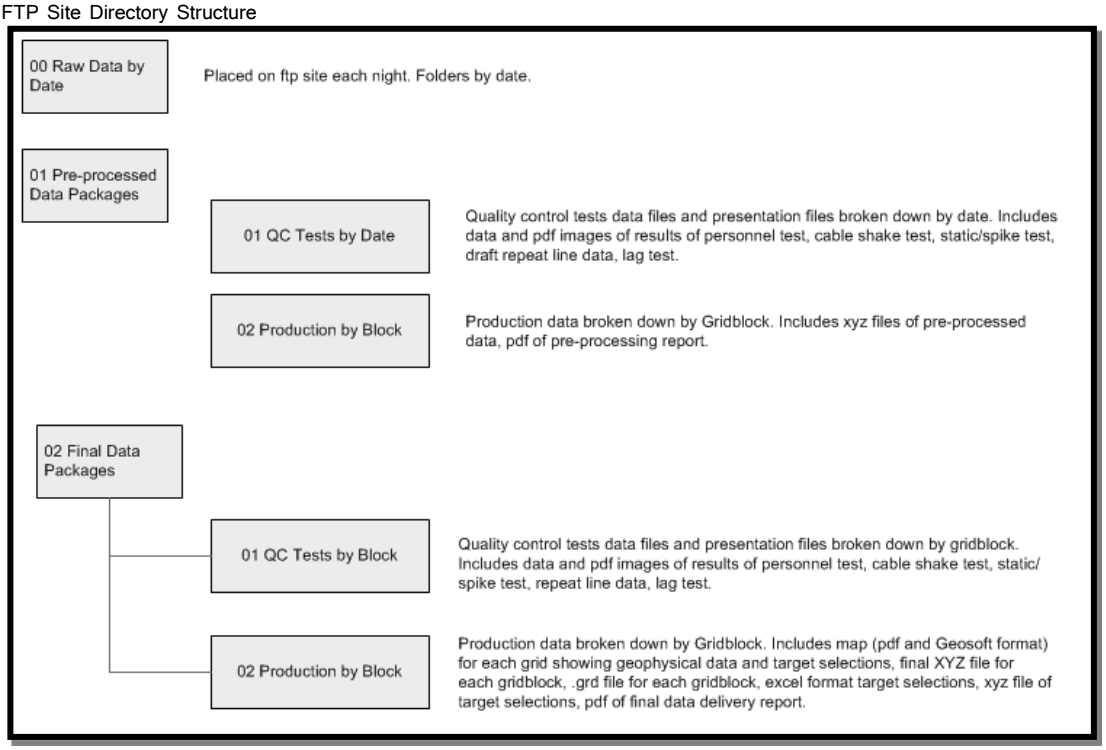
16.6 Records Management

Data files and deliverables will be available for quality assurance (QA) verification throughout the project in order to verify that field and data processing procedures are implemented according to this GIP. Raw data files, final processed data files, hard copies, and field notes will be maintained for the duration of the project.

16.7 Final Reports, Maps and Geophysical Data

Geophysical data will be provided via a Secure File Transfer Protocol (FTP) site maintained by CH2M HILL. Data will also be provided on DVD or CD with the final report. **Figure 5** presents the folder structure that will be used on the FTP site.

FIGURE 5
FTP Site Directory Structure



The deliverable requirements and data delivery schedule include the following:

- Raw data will be provided by the DGM subcontractor to CH2M HILL on a daily basis. Raw data are defined as data files stored on the instrument data logger, without any modification (or filtering) that changes the originally recorded values from the geophysical sensor and positional instrument (if applicable).
  - *File Format* - Raw data will be provided as American Standard Code for Information Interchange (ASCII) text format so the data files are viewable in text editing software. Proprietary binary format data will be directly converted to text format before delivery.
  - *Naming Convention* - Each delivered raw file will have an informative and unique name. Daily production raw files will have the acquisition date as part of the file name.
- Within 3 working days of data collection, the DGM subcontractor will provide CH2M HILL pre-processed data. The following applies to pre-processed data deliverables:
  - Pre-processed geophysical data, including QC tests, will be delivered in Geosoft database (GDB) and xyz format, readable by Geosoft.
  - QC test databases and Adobe Acrobat Portable Document Format (PDF) files containing images of QC test results will be provided and organized by date.
  - Pre-processed production data will be provided by designated survey area (e.g. grid, grid block, transect, etc.)

  - An MRSIMS Pre-Processed Data Delivery Report in PDF format will be provided with designated survey area, which will contain field notes and pre-processing information. Information provided by the MRSIMS report is summarized in **Table 2**.
  - Pre-processed production data will be delivered in GDB or xyz format, and will include the following minimum channel information:
    - Easting (X) and Northing (Y) coordinates in site-specific UTM projection and in units of meters
    - Time (with precision to at least 0.1 second)
    - Raw geophysical data channels
    - Pre-processed geophysical data channels
- Within 5 days of data collection, the DGM subcontractor will provide CH2M HILL with final processed data. The following applies to the final processed data deliverables.
  - Processed geophysical data, including QC tests will be delivered in GDB or xyz format.
  - QC test databases and PDF files containing images of QC test results will be provided by survey area.
  - Processed production data will be provided by survey area.
  - An MRSIMS Final Data Delivery Report will be provided with each designated survey area, which will contain field notes and final processing information. Information provided by the MRSIMS report is summarized in **Table 2**.
  - Processed production databases will include the following minimum channel information:
    - Easting (X) and Northing (Y) coordinates in site-specific UTM projection (NAD 83) and in units of meters
    - Time (with precision to at least 0.1 second)
    - Raw geophysical data channels
    - Pre-Processed geophysical data channels
    - Processed geophysical data channels
  - Final deliverables will include:
    - Geosoft ".map" file for each grid
    - PDF of Geosoft map for each grid
    - Geosoft grid ".grd" file for survey area, showing gridded data from the channel used for anomaly selection
    - Microsoft Excel (i.e. MRSIMS format) and Geosoft ".xyz" target files for each grid (or a text file stating "there were no selected targets in Grid X", if applicable)

Final processed filenames will include the grid or survey area name.

Within 60 days of data collection, the processed geophysical field data, final maps and supporting geophysical interpretations will be provided by the DGM subcontractor.

TABLE 2
Processing Documentation Requirements

Information Type	Raw Data Delivery Report	Final Data Delivery Report	In File Headers
Site ID	X	X	X

TABLE 2
Processing Documentation Requirements

Information Type	Raw Data Delivery Report	Final Data Delivery Report	In File Headers
Geophysical instrument used	X	X	X
Positioning method used	X	X	X
Instrument serial numbers (geophysical and positioning)	X	X	
Coordinate system and unit of measure	X	X	X
Grid ID (or other identifier of surveyed area)	X	X	X
Date of data collection	X	X	X
Raw data file names associated with delivery	X	X	
Processed data file names associated with delivery	X	X	
Name of Project Geophysicist	X	X	
Name of Site Geophysicist	X	X	
Name of data processor	X	X	
Data processing software used with version number	X	X	
Despiking method and details	X	X	
Sensor drift removal and details	X	X	
Latency/lag correction and details	X	X	
Sensor bias, background leveling and/or standardization adjustment method and details		X	
PDF document showing graphical results of each field quality control test	X	X	
Geophysical noise identification and removal (spatial, temporal, motional, terrain induced) and details		X	
Other filtering/processing performed and details		X	
Gridding method		X	
Anomaly selection and decision criteria details		X	
Geosoft ".gdb" file for unit of survey being delivered (e.g. grid, grid block, or other area agreed upon with the client)		X	
Geosoft ".xyz" file for unit of survey being delivered (e.g. grid, grid block, or other area agreed upon with the client)		X	
Geosoft ".grd" file for unit of survey being delivered		X	
Geosoft ".map" file for unit of survey being delivered		X	
PDF of Geosoft map for unit of survey being delivered		X	
Other processing comments		X	
Date data processing is completed	X	X	
Data delivery date	X	X	
Scanned copy of field notes and field mobile data collection device notes (if applicable)	X		

SECTION 17

DGM Quality Control

The geophysical instruments will be field tested as part of the daily functional checks and as a means of reviewing system performance for compliance with the project MQOs. A description of each test, its acceptance criteria and frequency is provided below and summarized in **Table 3**.

- **Equipment Warm-up (Test #1)**. The EM61-MK2 will be turned on for a minimum of 10 minutes prior to use. Equipment warm-up is performed each time the instrument is first turned on for the day or has been off for an extended period of time, thereby allowing the instrument to "cool down."

- **Personnel Test (Test #2).** This test checks the response of instruments to the personnel and their clothing/proximity to the system. On a daily basis, instrument sensors are checked for their response to the personnel operating the system, with response observed in the field for immediate corrective action. The personnel test is conducted at the beginning of the survey operations for each work day.

- **Vibration Test (Cable Shake) (Test #3)**. This test checks the response of instruments to vibration. On a daily basis, instrument sensors are checked for their response to vibrations through shaking the cables and observing the response in the field for immediate corrective action. The vibration test is conducted at the beginning of the survey operations for each work day.

- **Static Background and Static Spike (Test #4).** Static tests are performed by keeping the survey equipment stationary and positioning them within, or close to, the survey boundaries in an area relatively free of sources of metallic interference. Data are initially collected for a specific period (typically 1 minute) in order to measure background conditions. While keeping the instrument in a fixed position, data are recorded with a "spike" (e.g. ISO) placed at an accurately measured distance and orientation from the sensor. The purpose of the static test is to determine whether unusual levels of instrument or ambient noise exist. The static background and static spike test are conducted at the beginning and end of each survey operation as well as in between each designated survey area. For example, if the data are collected as blocks (where one block comprises several transects), the static tests will also be conducted in between each block. Therefore, this test effectively "opens" and "closes" out a survey area.

  The ISO can be placed above or below the sensor so long as the distance is measured from the ISO center of mass to the center of the sensor. For the EM61-MK2, the center of the sensor corresponds to the center of the horizontal plane of the transmit coil (top of coil if item placed above coil, bottom of coil if item placed below), as illustrated in **Figure 6**.

FIGURE 6
Example Spike Test Setup

- **Repeat Data (Test #5):** This test is performed in order to evaluate repeatability of the data and will be performed between collection of a survey area (grid, grid block, set of transects, etc.) after the initial survey over that area. Because of the intrinsic difficulty of following the exact same path for collecting repeat data, this test will be a qualitative comparison as opposed to quantitative.

TABLE 3
Geophysical Instrument Standardization Tests and Acceptance Criteria

Test	Test Description	Acceptance Criteria	Power On	Beginning of Day	Beginning and End of Day	Between Survey Areas	~2% of Daily Area Surveyed
1	Equipment Warm-up	Equipment specific (minimum 10 minutes)	X				
2	Personnel Test	Personnel, clothing, etc. should not result in EM61-MK2 Channel 2 data spikes >2 mV from the mean		X			
3	Vibration Test (Cable Shake)	Data profile does not exhibit EM61-MK2 Channel 2 data spikes >2 mV from the mean		X			
4	Static Background and Static Spike	±20% of standard item response, after background correction			X	X	
5	Repeat Data (Person Portable System)	Qualitative repeatability of response amplitude					X

mV = millivolt

SECTION 18

QC Seed Items

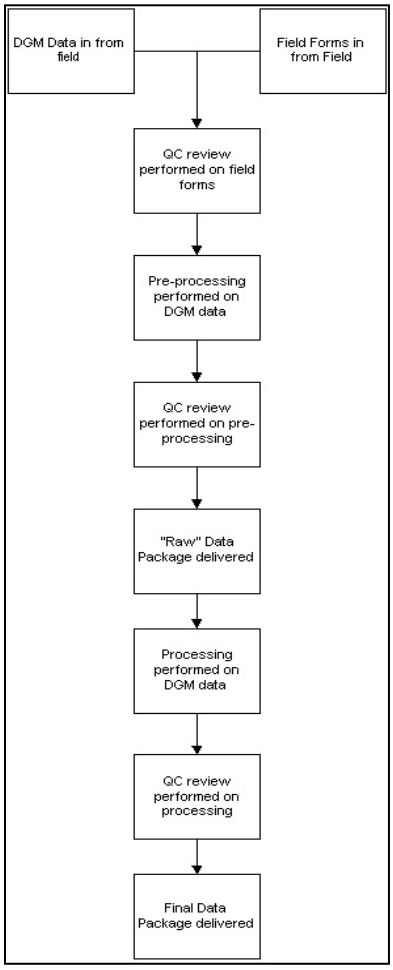
QC seed items, consisting of small ISOs, will be buried approximately every 13,124 linear feet (4,000 linear meters) along the DGM transects. Details of the blind seeding program are provided in the GSV Work Plan, included in **Appendix E**.

SECTION 19

QC of DGM Data and Deliverables

CH2M HILL will perform QC of geophysical data and data deliverables at each step of the processing path. **Figure 7** depicts the processing path and the QC steps performed. Data will not move to the next stage until they have passed each QC check.

FIGURE 7
Quality Control of DGM Data – Process Flow Path



SECTION 20

Corrective Measures

Specific corrective measures are dependent on the type of geophysical equipment used. However, the following are the basic corrective measures to be followed in association with the DGM surveying:

- Replacement of sensors if they fail to meet functional check requirements.
- Re-collection of survey area units (i.e. grids) if seeded items are not identified (do not appear in the DGM data).
- Re-analysis of the DGM data if there is a failure to select a seed item as a target anomaly, but the item is clearly present in the DGM data.

SECTION 21

Handheld Geophysical Instrument Quality Control

QC of the handheld geophysical instruments will be accomplished through daily functional checks prior to using them for field activities. Each instrument will be operated over a small metallic item buried close to the maximum detection depth determined for that item during instrument validation. If the instrument is not able to detect the item, it will be taken out of service until it can be repaired.

SECTION 22

References

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Appendix C
Geophysical System Verification Plan

Attachment C (Final)

Geophysical System Verification Plan
UXO-21 – Former D-Area Tear Gas Chamber
Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Prepared for
Naval Facilities Engineering Command Mid-Atlantic
Contract Number: N62470-11-D-8012

CTO-WE54

May 2013

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Figures

Acronyms and Abbreviations

2D MAR DIV	2nd Marine Division
bgs	Below Ground Surface
cm	Centimeter
DGM	Digital Geophysical Mapping
ft	Feet
GIP	Geophysical Investigation Plan
GPS	Global Positioning System
GSV	Geophysical System Verification
in	Inch
ISO	Industry Standard Object
IVS	Instrument Verification Strip
m	Meter
MCIEAST-MCB CAMLEJ	Marine Corps Base Camp Lejeune
MEC	Munitions and Explosives of Concern
MPPEH	Material Potentially Presenting an Explosive Hazard
MQO	Measurement Quality Objective
MRS	Munitions Response Site
mV	MilliVolt
NRL	Naval Research Laboratory
QC	Quality Control
UXO	Unexploded Ordnance

SECTION 1

Geophysical System Verification Plan

The Geophysical System Verification (GSV) process is a physics-based presumptively-selected technology process in which signal strength and sensor performance are compared to known response curves of industry standard objects (ISOs) to verify digital geophysical mapping (DGM) systems prior to and during site surveys. The GSV process is designed to perform initial verification of the proposed DGM system using an instrument verification strip (IVS) followed by a blind seeding program for continued verification throughout the field operations.

The GSV process will be implemented for the EM61-MK2 survey to be conducted in support of a Phase II Exanded Site Investigation at Munitions Response Site (MRS) UXO-21 – Former D-Area Gas Chamber, 2nd Marine Division (2D MAR DIV), at Marine Corps Base Camp Lejeune (MCIEAST-MCB CAMLEJ) in Jacksonville, North Carolina.

1. Instrument Verification Strip

The initial phase of the GSV process is verification of the selected DGM system using an IVS. The IVS will be a land-based IVS.

1.1 Personnel and Qualifications

The following individuals will be involved in the IVS, GSV process, and DGM production survey:

- Project/Quality Control (QC) Geophysicist (CH2M HILL)
- Site Geophysicist (DGM Subcontractor)
- Field Geophysicist (DGM Subcontractor)
- Data Processor (DGM Subcontractor)
- Unexploded Ordnance (UXO) personnel (CH2M HILL)

Personnel involved in performance of the IVS and the production geophysical surveys will meet the following qualifications and have the following responsibilities throughout the duration of the survey:

- The **Project/QC Geophysicist** will have a degree in geophysics, geology, geological engineering, or a closely related field, and have a minimum of 5 years of directly related geophysical experience working at MEC and MPPEH sites. This individual will be responsible for constructing the IVS for use during DGM operations. This individual will also be capable of overseeing geophysical operations and support activities (e.g. land surveying, vegetation clearing), serving as the project team technical lead, performing QC of data as packages are delivered, and coordinating with the CH2M HILL project manager.
- The **Site Geophysicist** will have a degree in geophysics, geology, geological engineering, or a closely related field, and have a minimum of 2 years of directly related geophysical experience working at sites with Munitions and Explosives of Concern (MEC) and Material Potentially Presenting an Explosive Hazard (MPPEH). This individual will serve as the subcontractor primary point of contact in the field, be capable of managing field staff, maintain geophysical equipment, perform in-field data quality checks and make sure that field work and records management is completed in accordance with the project work plans and health and safety plan.
- The **Field Geophysicist** will have a degree in geophysics, geology, geological engineering, or a closely related field and will have had training in the proper and safe operation of geophysical equipment. This individual will have at least 6 months of related geophysical experience working at MEC and MPPEH sites.
- The **Data Processor** will have a degree in geophysics, geology, geological engineering, or a closely related field, and will have at least 1 year of experience in processing geophysical data related to MEC and MPPEH projects.

- **UXO Personnel** will be responsible for overall daily site access and safety aspects of the project, compiling subcontractor health and safety documents, conducting daily safety briefings and performing MEC avoidance, as needed, in the field. Information on the specific qualifications for various UXO personnel support roles can be found in the Explosives Safety Submission (ESS).

1.2 Digital Geophysical Mapping System

DGM at UXO-21 will be conducted using the Geonics, Ltd. EM61-MK2. The EM61-MK2 has been presumptively selected based on existing site conditions, findings of the PA/SI and Expanded SI and successful prior use of the EM61-MK2 at UXO-21 and elsewhere at MCIEAST-MCB CAMLEJ.

The EM61-MK2 survey will be conducted along transects and will consist of a single coil, person-portable system to map geophysical anomalies that could potentially represent subsurface MEC or MPPEH. The EM61-MK2 survey at UXO-21 will likely be conducted using wheel mode. However, the DGM subcontractor may elect to utilize two-person litter (i.e. tandem) mode collection if ground surface conditions are determined to not be very conducive to the use of the system on its standard wheels.

The QC program to be implemented for the DGM production survey is presented in the Geophysical Investigation Plan (GIP) (**Appendix C**).

1.2.1 Geonics, Ltd. EM61-MK2

The EM61-MK2 is a high-resolution time-domain electromagnetic (EM) instrument designed to detect, with high spatial resolution, shallow ferrous and nonferrous metallic objects. The standard EM61-MK2 system consists of two air-cored, 1 meter (m) by 0.5 m (3.3 feet [ft] by 1.2 ft) coils, a digital data recorder, batteries and processing electronics. The EM61-MK2's transmitter generates a pulsed primary magnetic field, which then induces eddy currents in nearby metallic objects. Each of the two spatially separated receiver coils measures these eddy currents. The EM61-MK2 offers the ability to measure the eddy currents at three distinct time intervals in the bottom coil or four intervals if no top coil measurements are recorded. Earlier time gates provide enhanced detection of smaller metallic objects. Secondary voltages induced in both coils are measured in millivolts (mV). The arrangement of coils is such that there is a vertical separation of 40 centimeters (cm) (15.7 inches [in]). To obtain as much information about the decay of the induced EM signal as possible, the top coil will not be used at this site as a data channel, and four bottom coil sensor channels will be recorded. Assuming accurate data positioning, target resolution of approximately 50 cm (20 in) can be expected.

1.3 Positioning Method

Location control for the EM61-MK2 data will be performed using fiducial positioning methods. It is assumed that site conditions will not be conducive to the use of a global positioning system (GPS). Fiducial methods use a time-marking procedure to determine the spatial location of the collected data. Using this approach, transects are established over the site to survey-grade accuracy (0.1 ft [3 centimeters [cm]]). Wooden stakes are placed at the beginning and end of each lane and at surveyed positions along each transect (e.g. every 80 ft [25 m]). Transect establishment is performed by a licensed professional land surveyor (PLS) in advance of the DGM.

1.4 Location and Length of IVS

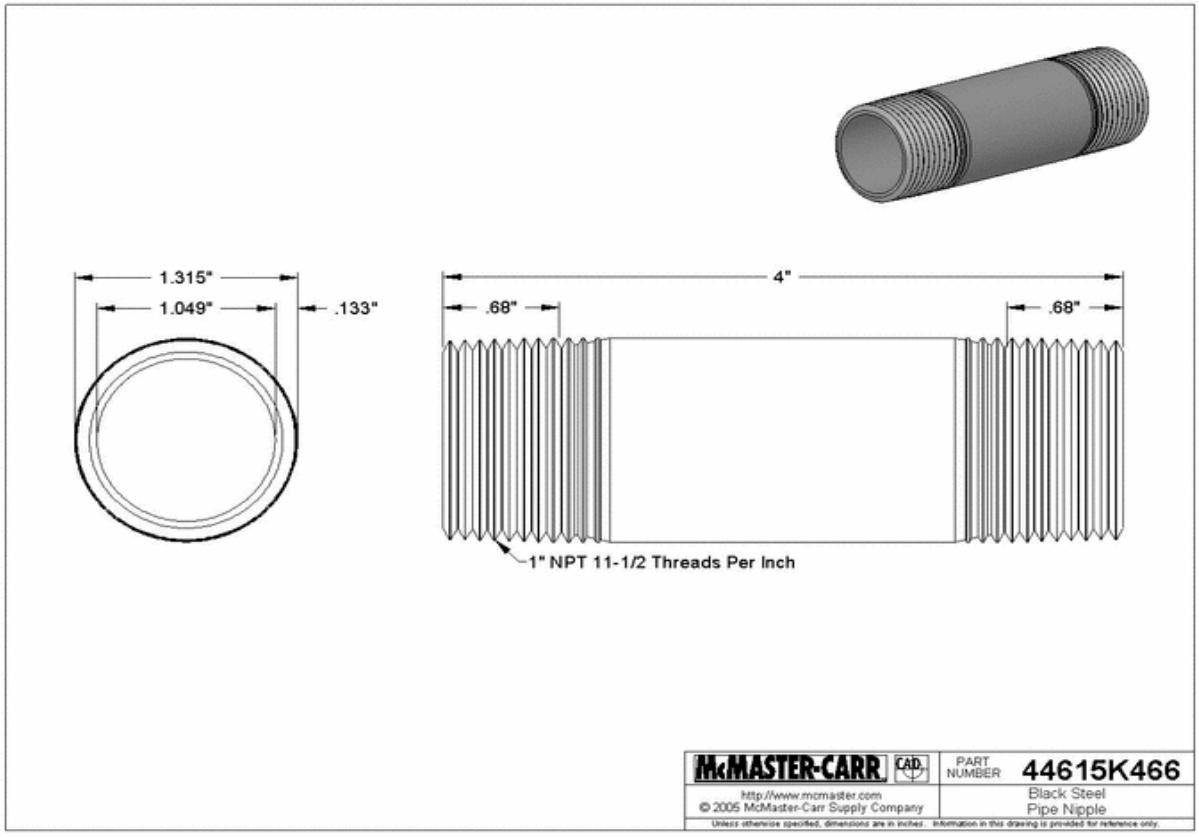
An area near the DGM survey area will be selected for the IVS. The exact location of the IVS will be finalized during the initial mobilization to the site. The IVS will be set up as a series of survey lanes, each with a minimum length of 20 m (66 ft). **Section 1.5** provides additional details on the IVS set-up and construction.

1.5 Industry Standard Objects

The ISOs (**Figure 1**) to be used in the IVS are 1-inch by 4-inch (2.54-centimeter [cm] by 10.16 cm) steel pipes (McMaster-Carr part number 44615K466 [http://www.mcmaster.com/]) with the following specifications:

Shape: Straight Nipple, Threaded Both Ends
Schedule: 40
Pipe Size: 1 inch (1.315 inch outer diameter [OD])
Length: 4 inches
Finish: Black Welded Steel.

FIGURE 1
Small ISO

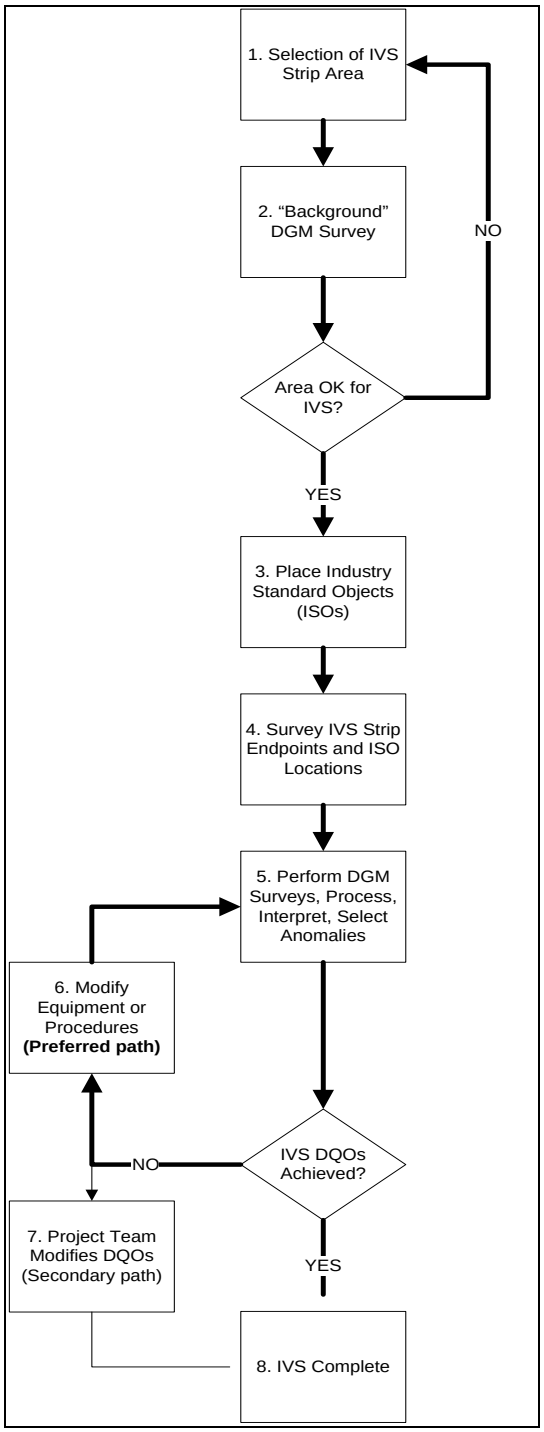


Instrument response curves for this ISO have been developed by the Naval Research Laboratory (NRL) demonstrating their standard response under their most favorable orientation (perpendicular to the EM61-MK2 instrument plane, i.e. buried vertically in the ground surface) and least favorable orientation (parallel to the instrument plane, i.e. buried horizontally and perpendicular to the direction of travel with the EM61-MK2) at a variety of distances from the instrument's bottom transmit/receive coil (NRL, 2009).

1.6 IVS Procedures

Figure 2 illustrates the overall IVS process and the procedures to be employed (numbered in accordance with the steps shown on **Figure 2**) during site work.

FIGURE 2
IVS Process



1. An IVS area will be selected with preference for the following (although none of the conditions are vital for IVS success):

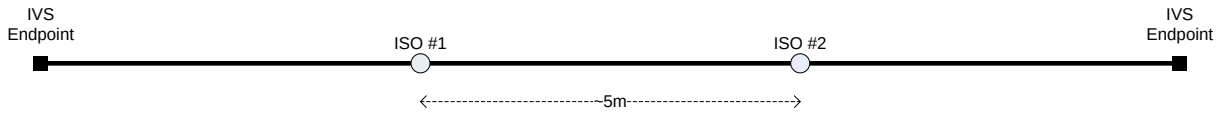
- Terrain, geology, and vegetation similar to that of a majority of the DGM survey area.
- Geophysical noise conditions similar to those expected across the survey area.
- Large enough site to accommodate all necessary IVS tests and equipment and for adequate spacing (at least 3 m) of the ISO items to avoid ambiguities in data evaluation.

- Readily accessible to project personnel.
- Close proximity to the actual survey site (if not within the site).

2. A background DGM survey will be performed with the EM61-MK2. This step will help determine the appropriateness of the location (e.g. few existing anomalies), and will verify that ISOs are not seeded near existing anomalies. The data will be processed and provided to the CH2M HILL Project/QC Geophysicist for evaluation.

3. Once the IVS area is deemed suitable for use, (i.e. free of significant subsurface anomalies or anomalies that are clearly identified so that they can be avoided during seeding), two small ISOs will be buried at depths below ground surface (bgs) of approximately 3 and 7 times the small ISO diameter (10 cm and 23 cm, respectively). The ISO will be placed in a plastic sealable bag, identified as inert and labeled with the applicable contract number and CH2M HILL project manager contact information. These depths are intended to provide adequate signal to noise ratio for detecting the items. The generalized set-up of the seeded IVS transect is presented as **Figure 3**.

Figure 3
Generalized IVS Seeded Transect



Measurements of the item depths will be to the center of mass of each item. CH2M HILL on-site personnel will bury the ISOs using shovels to dig the holes to the appropriate depths for burial of the seed items in coordination with the Project/QC Geophysicist. The background survey data and anomaly avoidance techniques will be reviewed so that transect start and end stakes and the seed items are not placed on top of or near existing anomalies. Personnel will bury the ISOs and record the emplacement depth and orientation.

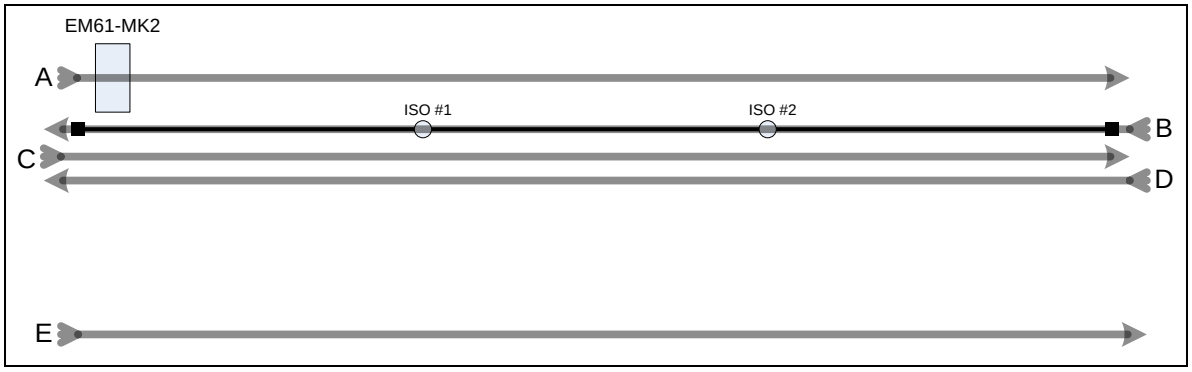
4. Either the land surveying or DGM subcontractor will record the locations of the IVS transect start and end locations as well as the buried ISOs. The holes will then be filled with soil and a vinyl-stem flag or wooden survey stake will be placed at each ISO location. If wooded stakes are used, they will not extend more than 1 ft above the ground surface so that the EM61-MK2 can easily pass over top of their locations.

5. A DGM survey using fiducial positioning methods will be performed over the IVS area, including transects as described in **Table 1** and shown on **Figure 4**.

TABLE 1
IVS Transect Descriptions and Purpose

Transect	Description	Purpose
A	Offset by 0.75 m	Demonstrate horizontal drop off of item response
B	Directly over center of strip (see **Figure 3**)	Verify response versus established response curves
C	Offset by 0.375 m (half of intended lane separation) from center of strip	Demonstrate horizontal drop off of item response
D	Offset by 0.75 m (on opposite side of strip from Transect A)	Demonstrate horizontal drop off of item response
E	Offset by ~3 m from strip	Measure background noise

FIGURE 4
IVS Layout



The IVS will be established with Transects A and D at a spacing of 0.75 m and Transect C at a spacing of 0.375 m relative to the center strip. Details on the DGM production survey approach are provided in the GIP.

The IVS "5-line" survey data will be processed and interpreted by the DGM subcontractor's data processor and provided to the CH2M HILL Project/QC Geophysicist within 24 hours of completion of the IVS survey.

- If the initial measurement quality objectives (MQOs) have not been met, the Project/QC Geophysicist will discuss with the Site Geophysicist whether modifications to instrumentation or procedures can be made to the DGM system in order to meet the MQOs.
- If the MQOs cannot be met, the Project/QC Geophysicist will meet with the project team to discuss potential resolutions (e.g. modification of a MQO) prior to completing the IVS and beginning the production survey.
- Once the system has been determined to meet the initial (or modified) MQOs, the IVS survey will be complete.

1.7 Measurement Quality Objectives

The MQOs for the IVS are presented in **Table 2**. The EM61-MK2 will not be used for site surveys until it is able to meet these MQOs or until the project team agrees on modifications to existing MQOs.

TABLE 2
IVS MQOs

Measurement Quality Objective	Measurement Performance Criteria	Test Method During IVS
General System Verification		
DGM System Positioning. Accurate coordinates are obtained from kinematic (i.e. in-motion) DGM positioning systems.	Positional error of ISO seeds will not exceed 25 cm (9.8 inches) relative to surveyed locations.	Results of IVS DGM survey versus IVS seed locations will be evaluated for compliance.
DGM System Munitions Detection. DGM system response is within industry standards for detection.	Response to buried ISO will not vary more than ±20% from known response for specific distance from sensors in static test.	Results of IVS surveys over seed items in strip will be qualitatively reviewed for the person portable system. Results of static tests described in GIP will be quantitatively reviewed for compliance for each system used.
Data Handling		
Data must be delivered in a timely manner and in a useable format.	IVS survey results are delivered within 24 hours of completion of survey. Final processed packages delivered within 3 days.	Evaluate based on actual delivery of data

Additional MQOs for the production survey will be monitored through the blind seeding program and other QC tests, as discussed in the GIP. The IVS MQOs, measurement performance criteria, and test method to be used during the IVS are discussed in detail in the following subsections.

1.7.1 General System Verification

DGM System Positioning

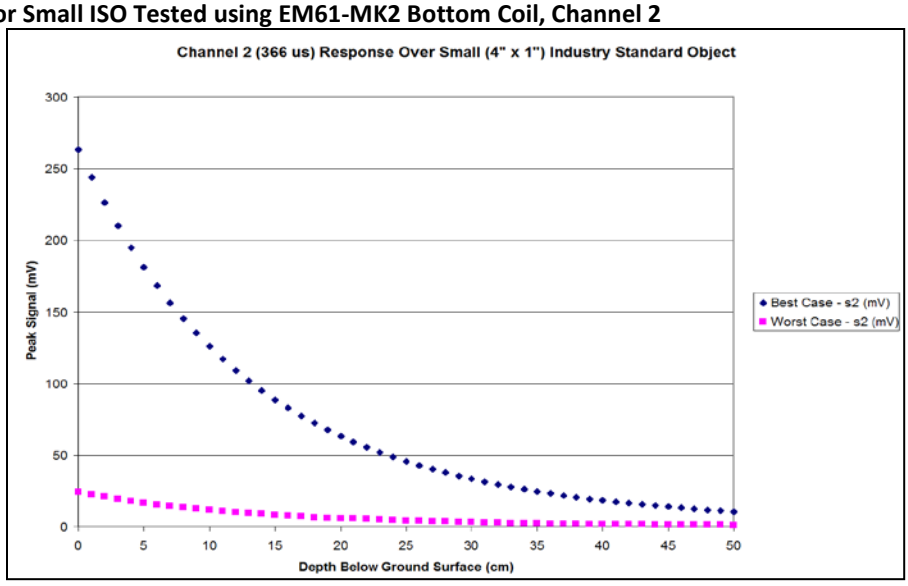
The MQO for DGM system positioning is that the resulting anomaly coordinates from the DGM survey from the seeded ISOs are at a sufficient accuracy to allow for appropriate relocation of MEC items for intrusive investigation. The measurement performance criterion for this is that the positional error at known IVS seed locations will not exceed 25 cm (9.8 in).

DGM System Munitions Detection

The MQO for munitions detection is to demonstrate that the EM61-MK2 system is capable of detecting munitions items within industry standards. This process involves demonstrating that the maximum amplitude response from an ISO falls within 20% of the predicted, published sensor response for that item (NRL, 2009). Once it has been demonstrated that the system responds comparably, a cross correlation of industry experience with detection of munitions items can be assumed. In other words, the depths and orientations of munitions items which the EM61-MK2 has been shown to be effective under test scenarios and other projects can be expected (NRL, 2008). **Figure 5** presents the EM61-MK2 predicted responses for Channel 2 from a small ISO (NRL, 2009).

The static spike test results (discussed in the GIP) will determine whether the geophysical instrument is responding to within a specific threshold. In this test, the distance from the coil and orientation of the ISO can be strictly controlled in the field.

FIGURE 5
NRL (2009) Results for Small ISO Tested using EM61-MK2 Bottom Coil, Channel 2



Minor variations in the sensor height as it passes over the seeded item and slight variations in the path traveled down the IVS can affect the amplitude response received from the instrument. Therefore, the responses from the seeded ISOs in the IVS will be qualitatively evaluated for person portable systems. A determination that the geophysical instrument itself is responding within a specific threshold will be through the static spike test results.

1.6.2 Data Handling

The MQO for data handling is that data must be delivered in a timely manner and in a useable format. Because of the need for rapid feedback during IVS operations to effectively test potential DGM systems, the measurement performance criterion for data handling during IVS activities will require that initial data be completed and delivered to the Project/QC Geophysicist within 24 hours of data collection. Processed data for the IVS shall be

delivered to the Project/QC Geophysicist within three working days of data collection. This MQO will be evaluated based on the actual delivery of data from the subcontractor.

1.8 IVS Data Analysis and Interpretation

The IVS survey data will be post-processed and analyzed per the data processing standard operating procedures (SOPs) and in accordance with **Section 16** of the GIP.

1.9 DGM Quality Control

Achievement of the GSV MQOs will be verified by the CH2M HILL Project/QC Geophysicist. The selected IVS area, the process of emplacing the IVS items, and the survey locations will be verified through observation during the IVS set-up and execution. SOPs provided by the subcontractor prior to mobilization will be reviewed for compliance with the GIP and to confirm that equipment functional checks are established and utilized.

The QC tests discussed in detail in **Section 17** of the GIP (**Appendix C**) will be performed as part of the GSV and IVS procedure for the DGM systems being utilized.

1.10 IVS Data Evaluation and Reporting

The Project/QC geophysicist will evaluate the IVS survey results and QC tests as the last step in the validation process.

2. Blind Seeding

As a continuation of the GSV process and on-going verification of the EM61-MK2 system operation, small ISOs will be used as blind seeds approximately every 13,124 linear feet (4,000 linear meters) along the DGM transects.

2.1 Seed Placement

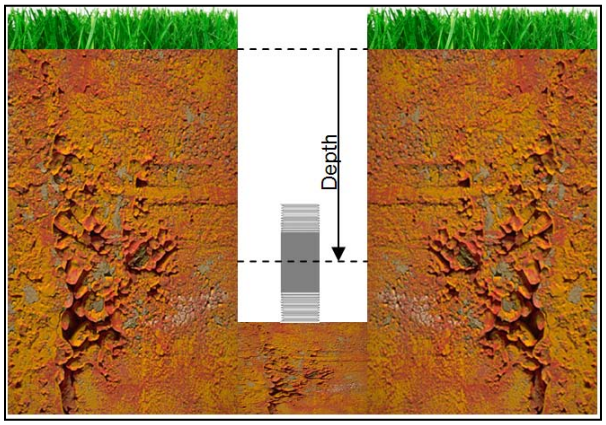
CH2M HILL will bury seed items with a vertical orientation and at a depth of six inches (15.2 centimeters) bgs. Depth will be measured to the center of mass of the item, as illustrated in **Figure 6**. Depths will be recorded in field notes.

UXO personnel will utilize a White's XLT all metals detector to clear the locations of each proposed seed location in order to avoid placing the seed near a subsurface metallic object. The following also applies to the placement of the seed items:

- UXO personnel will clear the proposed seed locations to make sure there are no potentially competing subsurface anomalies that may impact the ability to successfully detect the seed items with the geophysical instruments.
- Seeds will not be placed within a 1 m (3.3 ft) radius of a surveyor stake, tree, or other physical obstruction.
- Holes will be dug by UXO personnel or under their direct supervision.
- The seed items will be left exposed after emplacement so that the land surveying subcontractor can record the locations of the items. The surveyor will record the location of the center of the seed items.
- The seed items will be labeled with the CH2M HILL project manager name and contact information, as well as the applicable contract number for the project. They will be placed in a sealed plastic bag or securely wrapped in non-metallic material to prevent groundwater from obscuring the labels.
- Once surveyed, the seeds will be carefully covered with soil so as to not disturb their orientation.

- No physical markers will be left in place to denote the locations of the seed items.
- The locations of the seed items will be provided to the CH2M HILL Project/QC Geophysicist.

FIGURE 6
QC Seed Burial Illustration



2.2 Validation

During review of the delivered data packages, the Project/QC geophysicist will overlay the locations of the blind seeds to observe whether the munitions detection and positioning MQOs are met. Should an issue be detected (such as a data trend indicating a MQO limit is being approached) or a MQO is not met, a comprehensive root-cause analysis will be performed and a corrective action determined.

3. Reporting

Results of the GSV process will be included in a report prepared by CH2M HILL. The report will include a summary of the IVS operations and initial validation, an as-built map of the IVS plot, discussion of the IVS and blind seeding program results.

4. References

Naval Research Laboratory, 2009. *EM61-MK2 Response of Three Surrogates, NRL/MR/6110-09-9183*. March.

Naval Research Laboratory, 2008. *Final Report for the Evaluation of UXO Detection Technology at the Standardized UXO Test Sites Aberdeen and Yuma Proving Grounds, Standardized UXO Technology Demonstration Site Program, SERDP. NRL/MR/6110-08-9155 (EM61-MK2 Response of Standard Munitions Items)*. October.

Appendix D
Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I Purpose

The purpose of this SOP is to provide information on chain-of-custody procedures to be used under the CLEAN Program.

II Scope

This procedure describes the steps necessary for transferring samples through the use of Chain-of-Custody Records. A Chain-of-Custody Record is required, without exception, for the tracking and recording of samples collected for on-site or off-site analysis (chemical or geotechnical) during program activities (except wellhead samples taken for measurement of field parameters). Use of the Chain-of-Custody Record Form creates an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis. This procedure identifies the necessary custody records and describes their completion. This procedure does not take precedence over region specific or site-specific requirements for chain-of-custody.

III Definitions

Chain-of-Custody Record Form - A Chain-of-Custody Record Form is a printed two-part form that accompanies a sample or group of samples as custody of the sample(s) is transferred from one custodian to another custodian. One copy of the form must be retained in the project file.

Custodian - The person responsible for the custody of samples at a particular time, until custody is transferred to another person (and so documented), who then becomes custodian. A sample is under one's custody if:

- It is in one's actual possession.
- It is in one's view, after being in one's physical possession.
- It was in one's physical possession and then he/she locked it up to prevent tampering.
- It is in a designated and identified secure area.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the point and time that it was collected.

IV. Procedures

The term "chain-of-custody" refers to procedures which ensure that evidence presented in a court of law is valid. The chain-of-custody procedures track the evidence from the time and place it is first obtained to the courtroom, as well as providing security for the evidence as it is moved and/or passed from the custody of one individual to another.

Chain-of-custody procedures, recordkeeping, and documentation are an important part of the management control of samples. Regulatory agencies must be able to provide the chain-of-possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

Sample Identification

The method of identification of a sample depends on the type of measurement or analysis performed. When *in situ* measurements are made, the data are recorded directly in bound logbooks or other field data records with identifying information.

Information which shall be recorded in the field logbook, when in-situ measurements or samples for laboratory analysis are collected, includes:

- Field Sampler(s),
- Contract Task Order (CTO) Number,
- Project Sample Number,
- Sample location or sampling station number,
- Date and time of sample collection and/or measurement,
- Field observations,
- Equipment used to collect samples and measurements, and
- Calibration data for equipment used

Measurements and observations shall be recorded using waterproof ink.

Sample Label

Samples, other than for *in situ* measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling and Analysis Plan. Each sample container is identified by a sample label (see Attachment A). Sample labels are provided, along with sample containers, by the analytical laboratory. The information recorded on the sample label includes:

- Project - CTO Number.
- Station Location - The unique sample number identifying this sample.
- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 08/21/12).
- Time - A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- Medium - Water, soil, sediment, sludge, waste, etc.
- Sample Type - Grab or composite.
- Preservation - Type and quantity of preservation added.
- Analysis - VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- Sampled By - Printed name of the sampler.
- Remarks - Any pertinent additional information.

Using only the work assignment number of the sample label maintains the anonymity of sites. This may be necessary, even to the extent of preventing the laboratory performing the analysis from knowing the identity of the site (e.g., if the laboratory is part of an organization that has performed previous work on the site). The field team should always follow the sample ID system prepared by the project EIS and reviewed by the Project Manager.

Chain-of-Custody Procedures

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed.

Field Custody Procedures

- Samples are collected as described in the site Sampling and Analysis Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the Chain-of-Custody Record exactly.

- A Chain-of-Custody Record will be prepared for each individual cooler shipped and will include ***only*** the samples contained within that particular cooler. The Chain-of-Custody Record for that cooler will then be sealed in a zip-log bag and placed in the cooler prior to sealing. This ensures that the laboratory properly attributes trip blanks with the correct cooler and allows for easier tracking should a cooler become lost during transit.

- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once downloaded to the server or developed, the electronic files or photographic prints shall be serially numbered, corresponding to the logbook descriptions; photographic prints will be stored in the project files. To identify sample locations in photographs, an easily read sign with the appropriate sample location number should be included.

- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label if the pen would not function in freezing weather.)

Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form. **A Chain-of-Custody Record Form must be completed for each cooler and should include only the samples contained within that cooler**. A Chain-of-Custody Record Form example is shown in Attachment B. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of-Custody Record is filled out as given below:

- Enter header information (CTO number, samplers, and project name).

- Enter sample specific information (sample number, media, sample analysis required and analytical method grab or composite, number and type of sample containers, and date/time sample was collected).

- Sign, date, and enter the time under “Relinquished by” entry.

- Have the person receiving the sample sign the “Received by” entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).

- If a carrier is used, enter the airbill number under “Remarks,” in the bottom right corner;

- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample-shipping package. Retain the copy with field records.

- Sign and date the custody seal, a 1-inch by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.

- Place the seal across the shipping container opening (front and back) so that it would be broken if the container were to be opened.

- Complete other carrier-required shipping papers.

The custody record is completed using waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the shipping container (enclosed with other documentation in a plastic zipper-type bag). As long as custody forms are sealed inside the shipping container and the custody seals are intact, commercial carriers are not required to sign the custody form.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis.

V Quality Assurance Records

Once samples have been packaged and shipped, the Chain-of-Custody copy and airbill receipt become part of the quality assurance record.

VI Attachments

A. Sample Label

B. Chain of Custody Form

C. Custody Seal

VII References

USEPA. *User's Guide to the Contract Laboratory Program*. Office of Emergency and Remedial Response, Washington, D.C. (EPA/540/P-91/002), January 1991.

STANDARD OPERATING PROCEDURE- C.1

Systematic Random Multi-Increment Sampling

I. Purpose

The Systematic Random Multi-Increment (MI) sampling of surface soil samples is performed to minimize any bias of sample representativeness introduced by compositional and distribution heterogeneity of constituents within the sample. This procedure should only be used when sampling surface soils for explosive residuals and metals.

II. Scope

Standard techniques for surface soil MI sampling for the analysis of explosives residuals and metals, and required equipment are provided in this SOP. These procedures do not apply to aliquots collected for VOCs, SVOCs, pesticides/herbicides, PCBs, or field GC screening (samples for these analyses should NOT be collected using MI sampling).

III. Equipment and Materials

MI sampling will be performed with clean hardened plastic or metal scoops, spoons, or coring tools depending on the cohesiveness of the soil. Sample containers will consist of two clean 16 ounce wide mouth glass jars for 1 kg samples and two clean 32 ounce wide mouth glass jars for 2 kg samples as required by the applicable analytical method. Soil will be homogenized in a clean stainless steel pan or bowl. Individual laboratory sample bottles will be required for Method 8330 and metals analysis, per analytical method requirements. Method 8330B samples will be shipped to the contract laboratory in a mass of not less than 3 kg per Decision Unit in sample containers supplied by the laboratory.

IV. Procedures and Guidelines

Surface soil composite samples will be collected from Decision Units for analysis for explosives residues and total metals. Each Decision Unit will be defined based on past range activities discovered during an archival records search. Decision units will have surveyed boundaries that may range in size from 10m x 10m to 100m x 100m. Each Decision Unit location and a summary of sampling activities will be recorded in a field book.

Multi-increment composite surface soil samples will be collected within the Decision Unit using a systematic sampling pattern with a random starting point. Number of increments should be between 30 and 100 depending on the size of the Decision Unit. Samples will be collected by walking from one corner of the grid

systematically back and forth across the entire grid area, collecting an increment of soil every so many paces, depending on the grid size and number of increments to be collected. The sample increments will be approximately equal in the amount of soil, which will be collected from depths of 0-2 inches below ground surface. After the entire Decision Unit has been walked, the individual increment samples will be composited into a single sample following the *Homogenization of Soil and Sediment Samples* SOP, prior to being transferred to the appropriate sample containers. Two replicate samples should be collected from each Decision Unit. Each replicate sample will be collected using the same method as the original sample. The replicate samples should be started from a different corner of the decision unit to avoid sampling the same location as the original sample. Figure 1 shows an example of how to do MI sampling in a Decision Unit that is 50m x 50m.

A total of 3 composite surface soil samples (1 original sample and two replicate samples) will be collected at each Decision Unit. Samples will be stored on ice in clean plastic bags or clean large mouth glass bottles and submitted for laboratory analysis by one or more of the following analytical methods: EPA SW-846 Method 8330, Method 8330B, and the appropriate project specific analytical methods for metals. Method 8330B uses an air drying and mechanical grinding process. Mechanical grinding will not be conducted for samples submitted for metals analysis. A minimum of 1 kg of soil will be collected per MI sample.

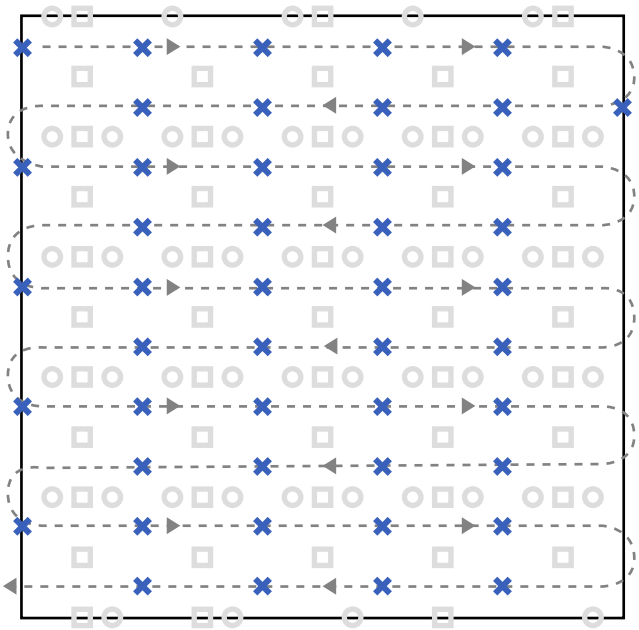
The sampling tools will not need to be cleaned between increments since each individual increment will be apart of the same sample, but tools will be cleaned between each MI sample. The decontamination process involves first removing all adhering soil, then rinsing the sampling head and pan/bowl with deionized water, concluding with an acetone rinse.

V. Attachments

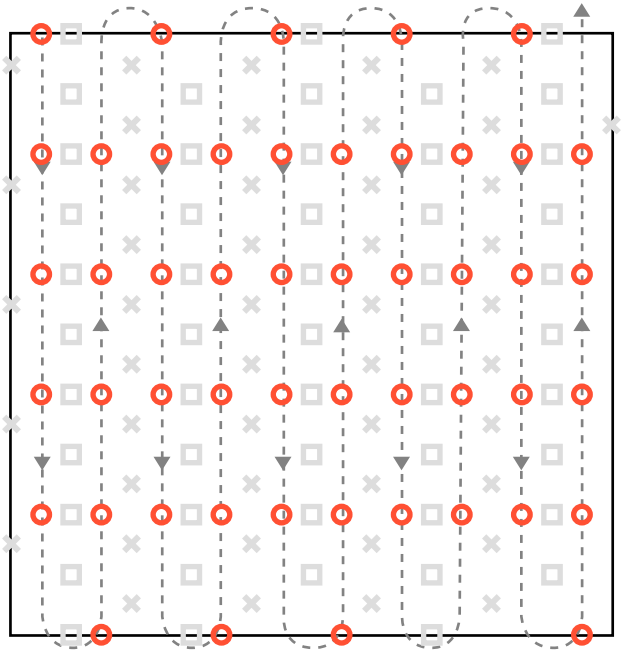
Figure 1- Systematic Random Multi-increment Sampling Pattern

VI. Key Checks and Items

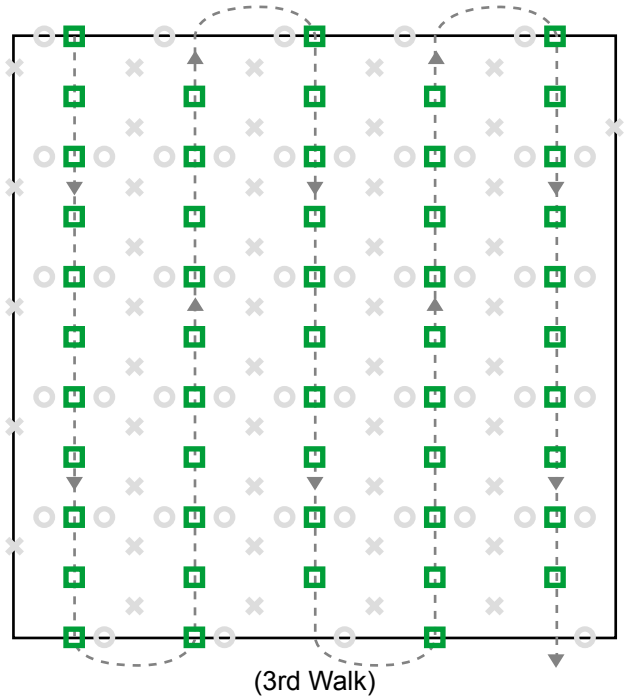
- A total of 3 composite surface soil samples (1 original sample and two replicate samples) will be collected at each Decision Unit.
- Replicate samples should be started from a different corner of the decision unit to avoid sampling the same location as the original sample.
- Increment samples should be homogenized in the field in a clean, stainless steel pan/bowl. Sampling method is only applicable to explosives residues and metals.
- Number of increments should be between 30 and 100 depending on the size of the Decision Unit.
- Check that decontamination of equipment is thorough.



(1st Walk)



(2nd Walk)



(3rd Walk)

LEGEND

Path of Travel

Sample Collection Point

10 m

5 m

FIGURE 1
Systematic- Random Multi-Increment Sampling Pattern

The MEC Removal Standard Operating Procedures will be inserted into this work plan after selection of the MEC Removal subcontractor.

Appendix E
Laboratory DoD ELAP Certification

LABORATORY ACCREDITATION BUREAU

Certificate # L2278

Scope of Accreditation
For
EMAX Laboratories, Inc.

1835 W 205th Street
Torrance, CA 90501
Kenette Pimentel
310-618-8889

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to **EMAX Laboratories, Inc.** to perform the following tests:

Accreditation granted through: **January 10, 2014**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	AK101	GRO
GC	AK102	DRO
GC	AK103	RRO
GFAA	CA 939M	Organo Lead
Platinum Electrode	EPA 120.1	Specific Conductance
Titrimetric	EPA 130.2	Hardness
Electrode	EPA 150.1	pH
Gravimetric	EPA 160.1	TDS
Gravimetric	EPA 160.2	TSS
Gravimetric	EPA 160.3	Total Residue
Turbidimetric	EPA 180.1	Turbidity
ICP	EPA 200.7	Aluminum
ICP	EPA 200.7	Antimony
ICP	EPA 200.7	Arsenic
ICP	EPA 200.7	Barium
ICP	EPA 200.7	Beryllium
ICP	EPA 200.7	Boron
ICP	EPA 200.7	Cadmium
ICP	EPA 200.7	Calcium
ICP	EPA 200.7	Chromium
ICP	EPA 200.7	Cobalt
ICP	EPA 200.7	Copper
ICP	EPA 200.7	Iron

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 200.7	Lead
ICP	EPA 200.7	Magnesium
ICP	EPA 200.7	Manganese
ICP	EPA 200.7	Molybdenum
ICP	EPA 200.7	Nickel
ICP	EPA 200.7	Potassium
ICP	EPA 200.7	Selenium
ICP	EPA 200.7	Silver
ICP	EPA 200.7	Sodium
ICP	EPA 200.7	Strontium
ICP	EPA 200.7	Thallium
ICP	EPA 200.7	Tin
ICP	EPA 200.7	Titanium
ICP	EPA 200.7	Vanadium
ICP	EPA 200.7	Zinc
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Zinc
IC	EPA 218.6	Hexavalent Chromium
COLD VAPOR	EPA 245.1	Mercury
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Chloride
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Bromide
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Phosphate
IC	EPA 300.0	Sulfate
IC	EPA 300.0	Bromate
IC	EPA 300M	Lactate
IC	EPA 300M	Acetate
IC	EPA 300M	Propionate
IC	EPA 300M	Butyrate
IC	EPA 300M	Pyruvate
IC	EPA 310.1	Alkalinity
IC	EPA 314.0	Perchlorate
Titrimetric	EPA 330.3	Total Residual Chlorine
Spectrometric	EPA 352.1	Nitrate-N
Spectrometric	EPA 353.3	Nitrate-N
Spectrometric	EPA 354.1	Nitrite-N
Spectrometric	EPA 365.2	Ortho-phosphate
Spectrometric	EPA 335.2	Cyanide
Spectrometric	EPA 350.2	Ammonia
Spectrometric	EPA 351.3	TKN
Spectrometric	EPA 365.2	Phosphorus
Spectrometric	EPA 370.1	Silica
Titrimetric	EPA 376.1	Sulfide
Spectrometric	EPA 376.2	Sulfide
Electrode	EPA 405.1	BOD
Spectrometric	EPA 410.4	COD
Combustion-IR	EPA 415.1	TOC
Spectrometric	EPA 420.1	Phenols
Spectrometric	EPA 425.1	MBAS
GC	EPA 504.1	DBCP
GC	EPA 504.1	EDB
GC	EPA 608	Aldrin
GC	EPA 608	alpha-BHC
GC	EPA 608	beta-BHC
GC	EPA 608	delta-BHC
GC	EPA 608	gamma-BHC (Lindane)
GC	EPA 608	DDD (4,4)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 608	DDE (4,4)
GC	EPA 608	DDT (4,4)
GC	EPA 608	Dieldrin
GC	EPA 608	Endosulfan I
GC	EPA 608	Endosulfan II
GC	EPA 608	Endosulfan sulfate
GC	EPA 608	Endrin
GC	EPA 608	Endrin Aldehyde
GC	EPA 608	Heptachlor
GC	EPA 608	Heptachlor epoxide
GC	EPA 608	Methoxychlor
GC	EPA 608	alpha-Chlordane
GC	EPA 608	gamma-Chlordane
GC	EPA 608	Endrin Ketone
GC	EPA 608	Toxaphene
GC	EPA 608	Technical Chlordane
GC	EPA 608	cis-Nonachlor
GC	EPA 608	DDD (2,4)
GC	EPA 608	DDE (2,4)
GC	EPA 608	DDT (2,4)
GC	EPA 608	Mirex
GC	EPA 608	Oxychlordane
GC	EPA 608	trans-Nonachlor
GC	EPA 608	PCB1016
GC	EPA 608	PCB1221
GC	EPA 608	PCB1232
GC	EPA 608	PCB1242
GC	EPA 608	PCB1248
GC	EPA 608	PCB1254
GC	EPA 608	PCB1260
GC	EPA 608	PCB1262
GC	EPA 608	PCB1268
GC-MS	EPA 624	Acrolein
GC-MS	EPA 624	Acrylonitrile
GC-MS	EPA 624	Benzene
GC-MS	EPA 624	Bromodichloromethane
GC-MS	EPA 624	Bromoform
GC-MS	EPA 624	Bromomethane
GC-MS	EPA 624	Carbon tetrachloride
GC-MS	EPA 624	Chlorobenzene
GC-MS	EPA 624	2-Chloroethyl vinyl ether
GC-MS	EPA 624	Chloroethane
GC-MS	EPA 624	Chloroform

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 624	Chloromethane
GC-MS	EPA 624	Dibromochloromethane
GC-MS	EPA 624	1,1-Dichloroethane
GC-MS	EPA 624	1,2-Dichloroethane
GC-MS	EPA 624	1,2-Dichlorobenzene
GC-MS	EPA 624	1,3-Dichlorobenzene
GC-MS	EPA 624	1,4-Dichlorobenzene
GC-MS	EPA 624	Dichlorodifluoromethane
GC-MS	EPA 624	1,1-Dichloroethene
GC-MS	EPA 624	cis-1,2-Dichloroethene
GC-MS	EPA 624	trans-1,2-Dichloroethene
GC-MS	EPA 624	1,2-Dichloropropane
GC-MS	EPA 624	cis-1,3-Dichloropropene
GC-MS	EPA 624	trans-1,3-Dichloropropene
GC-MS	EPA 624	Ethylbenzene
GC-MS	EPA 624	Methylene Chloride
GC-MS	EPA 624	tert-Butyl methyl ether
GC-MS	EPA 624	Styrene
GC-MS	EPA 624	1,1,2,2-Tetrachloroethane
GC-MS	EPA 624	Tetrachloroethene
GC-MS	EPA 624	Toluene
GC-MS	EPA 624	1,1,1-Trichloroethane
GC-MS	EPA 624	1,1,2-Trichloroethane
GC-MS	EPA 624	1,2,4-Trichlorobenzene
GC-MS	EPA 624	Trichloroethene
GC-MS	EPA 624	Trichlorofluoromethane
GC-MS	EPA 624	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 624	Vinyl Chloride
GC-MS	EPA 624	m-Xylene & p-xylene
GC-MS	EPA 624	o-Xylene
GC-MS	EPA 625	Acenaphthene
GC-MS	EPA 625	Acenaphthylene
GC-MS	EPA 625	Aniline
GC-MS	EPA 625	Anthracene
GC-MS	EPA 625	Azobenzene
GC-MS	EPA 625	Benzidine
GC-MS	EPA 625	Benzo(a)anthracene
GC-MS	EPA 625	benzo(a)pyrene
GC-MS	EPA 625	Benzo(b)fluoranthene
GC-MS	EPA 625	Benzo(e)pyrene
GC-MS	EPA 625	Benzo(g,h,i)perylene
GC-MS	EPA 625	Benzo(k)fluoranthene
GC-MS	EPA 625	Benzoic Acid

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 625	Benzyl Alcohol
GC-MS	EPA 625	Biphenyl
GC-MS	EPA 625	bis(2-chloroethoxy)methane
GC-MS	EPA 625	bis(2-chloroethyl)ether
GC-MS	EPA 625	bis(2-chloroisopropyl)ether
GC-MS	EPA 625	bis(2-Ethylhexyl)adipate
GC-MS	EPA 625	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 625	4-Bromophenyl-phenylether
GC-MS	EPA 625	Butylbenzylphthalate
GC-MS	EPA 625	Carbazole
GC-MS	EPA 625	4-Chloro-3-methylphenol
GC-MS	EPA 625	4-Chloroaniline
GC-MS	EPA 625	2-Chloronaphthalene
GC-MS	EPA 625	2-Chlorophenol
GC-MS	EPA 625	4-Chlorophenyl-phenylether
GC-MS	EPA 625	Chrysene
GC-MS	EPA 625	Dibenzo(a,h)anthracene
GC-MS	EPA 625	Dibenzofuran
GC-MS	EPA 625	1,2-Dichlorobenzene
GC-MS	EPA 625	1,3-Dichlorobenzene
GC-MS	EPA 625	1,4-Dichlorobenzene
GC-MS	EPA 625	3,3'-Dichlorobenzidine
GC-MS	EPA 625	2,4-Dichlorophenol
GC-MS	EPA 625	Diethylphthalate
GC-MS	EPA 625	2,6-Dimethylnaphthalene
GC-MS	EPA 625	2,4-Dimethylphenol
GC-MS	EPA 625	Dimethylphthalate
GC-MS	EPA 625	Di-n-butylphthalate
GC-MS	EPA 625	4,6-Dinitro-2-methylphenol
GC-MS	EPA 625	2,4-Dinitrophenol
GC-MS	EPA 625	2,4-Dinitrotoluene
GC-MS	EPA 625	2-6-Dinitrotoluene
GC-MS	EPA 625	Di-n-octylphthalate
GC-MS	EPA 625	1,2-Diphenylhydrazine
GC-MS	EPA 625	Fluoranthene
GC-MS	EPA 625	Fluorene
GC-MS	EPA 625	Hexachlorobenzene
GC-MS	EPA 625	Hexachlorobutadiene
GC-MS	EPA 625	Hexachlorocyclopentadiene
GC-MS	EPA 625	Hexachloroethane
GC-MS	EPA 625	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 625	Isophorone
GC-MS	EPA 625	1-Methylnaphthalene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 625	2-Methylnaphthalene
GC-MS	EPA 625	1-Methylphenanthrene
GC-MS	EPA 625	2-Methylphenol
GC-MS	EPA 625	4-Methylphenol
GC-MS	EPA 625	Naphthalene
GC-MS	EPA 625	2-Nitroaniline
GC-MS	EPA 625	3-Nitroaniline
GC-MS	EPA 625	4-Nitroaniline
GC-MS	EPA 625	Nitrobenzene
GC-MS	EPA 625	2-Nitrophenol
GC-MS	EPA 625	4-Nitrophenol
GC-MS	EPA 625	n-Nitrosodimethylamine
GC-MS	EPA 625	n-Nitroso-di-n-propylamine
GC-MS	EPA 625	n-Nitrosodiphenylamine
GC-MS	EPA 625	Pentachlorophenol
GC-MS	EPA 625	Perylene
GC-MS	EPA 625	Phenanthrene
GC-MS	EPA 625	Phenol
GC-MS	EPA 625	Pyrene
GC-MS	EPA 625	Pyridine
GC-MS	EPA 625	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 625	1,2,4-Trichlorobenzene
GC-MS	EPA 625	2,3,4-Trichlorophenol
GC-MS	EPA 625	2,3,5-Trichlorophenol
GC-MS	EPA 625	2,4,5-Trichlorophenol
GC-MS	EPA 625	2,4,6-Trichlorophenol
GC-MS	EPA 625	2,3,5-Trimethylnaphthalene
Gravimetric	EPA 1664A	Oil & Grease
Pensky-Martens	EPA 1010	Ignitability
ICP	EPA 6010B / 6010C	Aluminum
ICP	EPA 6010B / 6010C	Antimony
ICP	EPA 6010B / 6010C	Arsenic
ICP	EPA 6010B / 6010C	Barium
ICP	EPA 6010B / 6010C	Beryllium
ICP	EPA 6010B / 6010C	Boron
ICP	EPA 6010B / 6010C	Cadmium
ICP	EPA 6010B / 6010C	Calcium
ICP	EPA 6010B / 6010C	Chromium
ICP	EPA 6010B / 6010C	Cobalt
ICP	EPA 6010B / 6010C	Copper
ICP	EPA 6010B / 6010C	Iron
ICP	EPA 6010B / 6010C	Lead
ICP	EPA 6010B / 6010C	Magnesium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 6010B / 6010C	Manganese
ICP	EPA 6010B / 6010C	Molybdenum
ICP	EPA 6010B / 6010C	Nickel
ICP	EPA 6010B / 6010C	Potassium
ICP	EPA 6010B / 6010C	Selenium
ICP	EPA 6010B / 6010C	Silver
ICP	EPA 6010B / 6010C	Sodium
ICP	EPA 6010B / 6010C	Strontium
ICP	EPA 6010B / 6010C	Thallium
ICP	EPA 6010B / 6010C	Tin
ICP	EPA 6010B / 6010C	Titanium
ICP	EPA 6010B / 6010C	Vanadium
ICP	EPA 6010B / 6010C	Zinc
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Zinc
HPLC-MS	EPA 6850	Perchlorate
Spectrometric	EPA 7196A	Hex. Chromium

Non-Potable Water		
Technology	**Method**	**Analyte**
IC	EPA 7199	Hex. Chromium
Cold-Vapor	EPA 7470A / 7471A /7471B	Mercury
GC	EPA 8015B / 8015C	Gasoline
GC	EPA 8015B / 8015C	Diesel
GC	EPA 8015B / 8015C	Motor Oil
GC	EPA 8015B / 8015C	Diethylene Glycol
GC	EPA 8015B / 8015C	Ethanol
GC	EPA 8015B / 8015C	Ethylene Glycol
GC	EPA 8015B / 8015C	Isopropanol
GC	EPA 8015B / 8015C	JP4
GC	EPA 8015B / 8015C	Methanol
GC	EPA 8015B / 8015C	Propylene Glycol
GC	EPA 8015B / 8015C	JP5
GC	EPA 8081A / 8081B	Aldrin
GC	EPA 8081A / 8081B	alpha-BHC
GC	EPA 8081A / 8081B	beta-BHC
GC	EPA 8081A / 8081B	delta-BHC
GC	EPA 8081A / 8081B	gamma-BHC (Lindane)
GC	EPA 8081A / 8081B	DDD (4,4)
GC	EPA 8081A / 8081B	DDE (4,4)
GC	EPA 8081A / 8081B	DDT (4,4)
GC	EPA 8081A / 8081B	Dieldrin
GC	EPA 8081A / 8081B	Endosulfan I
GC	EPA 8081A / 8081B	Endosulfan II
GC	EPA 8081A / 8081B	Endosulfan sulfate
GC	EPA 8081A / 8081B	Endrin
GC	EPA 8081A / 8081B	Endrin Aldehyde
GC	EPA 8081A / 8081B	Heptachlor
GC	EPA 8081A / 8081B	Heptachlor epoxide
GC	EPA 8081A / 8081B	Methoxychlor
GC	EPA 8081A / 8081B	alpha-Chlordane
GC	EPA 8081A / 8081B	gamma-Chlordane
GC	EPA 8081A / 8081B	Endrin Ketone
GC	EPA 8081A / 8081B	Toxaphene
GC	EPA 8081A / 8081B	Technical Chlordane
GC	EPA 8081A / 8081B	cis-Nonachlor
GC	EPA 8081A / 8081B	DDD (2,4)
GC	EPA 8081A / 8081B	DDE (2,4)
GC	EPA 8081A / 8081B	DDT (2,4)
GC	EPA 8081A / 8081B	Mirex
GC	EPA 8081A / 8081B	Oxychlordane
GC	EPA 8081A / 8081B	trans-Nonachlor
GC	EPA 8082 / 8082A	PCB1016

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8082 / 8082A	PCB1221
GC	EPA 8082 / 8082A	PCB1232
GC	EPA 8082 / 8082A	PCB1242
GC	EPA 8082 / 8082A	PCB1248
GC	EPA 8082 / 8082A	PCB1254
GC	EPA 8082 / 8082A	PCB1260
GC	EPA 8082 / 8082A	PCB1262
GC	EPA 8082 / 8082A	PCB1268
GC	EPA 8082 / 8082A	PCB 8
GC	EPA 8082 / 8082A	PCB 18
GC	EPA 8082 / 8082A	PCB 28
GC	EPA 8082 / 8082A	PCB 44
GC	EPA 8082 / 8082A	PCB 52
GC	EPA 8082 / 8082A	PCB 66
GC	EPA 8082 / 8082A	PCB 77
GC	EPA 8082 / 8082A	PCB 81
GC	EPA 8082 / 8082A	PCB 101
GC	EPA 8082 / 8082A	PCB 105
GC	EPA 8082 / 8082A	PCB 114
GC	EPA 8082 / 8082A	PCB 118
GC	EPA 8082 / 8082A	PCB 123
GC	EPA 8082 / 8082A	PCB 126
GC	EPA 8082 / 8082A	PCB 128
GC	EPA 8082 / 8082A	PCB 138
GC	EPA 8082 / 8082A	PCB 153
GC	EPA 8082 / 8082A	PCB 156
GC	EPA 8082 / 8082A	PCB 157
GC	EPA 8082 / 8082A	PCB 167
GC	EPA 8082 / 8082A	PCB 169
GC	EPA 8082 / 8082A	PCB 170
GC	EPA 8082 / 8082A	PCB 180
GC	EPA 8082 / 8082A	PCB 187
GC	EPA 8082 / 8082A	PCB 189
GC	EPA 8082 / 8082A	PCB 195
GC	EPA 8082 / 8082A	PCB 206
GC	EPA 8082 / 8082A	PCB 209
GC	EPA 8082 / 8082A	PCB 110
GC	EPA 8141A / 8141B	Azinphos-methyl
GC	EPA 8141A / 8141B	Bolstar
GC	EPA 8141A / 8141B	Chlorpyrifos
GC	EPA 8141A / 8141B	Coumaphos
GC	EPA 8141A / 8141B	Demeton
GC	EPA 8141A / 8141B	Diazinon

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8141A / 8141B	Dichlorvos
GC	EPA 8141A / 8141B	Disulfoton
GC	EPA 8141A / 8141B	Ethoprop
GC	EPA 8141A / 8141B	Fensulfothion
GC	EPA 8141A / 8141B	Fenthion
GC	EPA 8141A / 8141B	Merphos
GC	EPA 8141A / 8141B	Mevinphos
GC	EPA 8141A / 8141B	Naled
GC	EPA 8141A / 8141B	Methyl Parathion
GC	EPA 8141A / 8141B	Phorate
GC	EPA 8141A / 8141B	Ronnel
GC	EPA 8141A / 8141B	Stirophos
GC	EPA 8141A / 8141B	Tokuthion
GC	EPA 8141A / 8141B	Trichloronate
GC	EPA 8141A / 8141B	Dimethoate
GC	EPA 8141A / 8141B	EPN
GC	EPA 8141A / 8141B	Famphur
GC	EPA 8141A / 8141B	Malathion
GC	EPA 8141A / 8141B	Ethyl Parathion
GC	EPA 8141A / 8141B	O,O,O-Triethylphosphorothioate
GC	EPA 8141A / 8141B	Sulfotepp
GC	EPA 8141A / 8141B	Thionazin
GC	EPA 8141A / 8141B	Tributyl Phosphate
GC	EPA 8151A	Acifluorfen
GC	EPA 8151A	Bentazon
GC	EPA 8151A	Chloramben
GC	EPA 8151A	2,4-D
GC	EPA 8151A	2,4-DB
GC	EPA 8151A	Dacthal
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	3,5 Dichlorobenzoic
GC	EPA 8151A	Dichlorprop
GC	EPA 8151A	Dinoseb
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	4-Nitrophenol
GC	EPA 8151A	Pentachlorophenol
GC	EPA 8151A	Picloram
GC	EPA 8151A	Silvex
GC	EPA 8151A	2,4,5-T
GC-MS	EPA 8260B	Acetone
GC-MS	EPA 8260B	Acrolein

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B	Acrylonitrile
GC-MS	EPA 8260B	Benzene
GC-MS	EPA 8260B	Bromobenzene
GC-MS	EPA 8260B	Bromochloromethane
GC-MS	EPA 8260B	Bromodichloromethane
GC-MS	EPA 8260B	Bromoform
GC-MS	EPA 8260B	Bromomethane
GC-MS	EPA 8260B	tert-Butyl alcohol
GC-MS	EPA 8260B	2-Butanone (MEK)
GC-MS	EPA 8260B	n-Butylbenzene
GC-MS	EPA 8260B	sec-Butylbenzene
GC-MS	EPA 8260B	tert-Butylbenzene
GC-MS	EPA 8260B	Carbon disulfide
GC-MS	EPA 8260B	Carbon tetrachloride
GC-MS	EPA 8260B	Chlorobenzene
GC-MS	EPA 8260B	2-Chloroethyl vinyl ether
GC-MS	EPA 8260B	Chloroethane
GC-MS	EPA 8260B	Chloroform
GC-MS	EPA 8260B	1-Chlorohexane
GC-MS	EPA 8260B	Chloromethane
GC-MS	EPA 8260B	2-Chlorotoluene
GC-MS	EPA 8260B	4-Chlorotoluene
GC-MS	EPA 8260B	Isopropyl ether (DIPE)
GC-MS	EPA 8260B	Dibromochloromethane
GC-MS	EPA 8260B	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B	1,2-Dibromoethane
GC-MS	EPA 8260B	Dibromomethane
GC-MS	EPA 8260B	1,1-Dichloroethane
GC-MS	EPA 8260B	1,2-Dichloroethane
GC-MS	EPA 8260B	1,2-Dichlorobenzene
GC-MS	EPA 8260B	1,3-Dichlorobenzene
GC-MS	EPA 8260B	trans-1,4-Dichloro-2-Butene
GC-MS	EPA 8260B	1,4-Dichlorobenzene
GC-MS	EPA 8260B	Dichlorodifluoromethane
GC-MS	EPA 8260B	1,1-Dichloroethene
GC-MS	EPA 8260B	cis-1,2-Dichloroethene
GC-MS	EPA 8260B	trans-1,2-Dichloroethene
GC-MS	EPA 8260B	Dichlorofluoromethane
GC-MS	EPA 8260B	1,1-Dichloropropene
GC-MS	EPA 8260B	1,2-Dichloropropane
GC-MS	EPA 8260B	1,3-Dichloropropane
GC-MS	EPA 8260B	2,2-Dichloropropane
GC-MS	EPA 8260B	cis-1,3-Dichloropropene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B	trans-1,3-Dichloropropene
GC-MS	EPA 8260B	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 8260B	Ethyl Methacrylate
GC-MS	EPA 8260B	Ethylbenzene
GC-MS	EPA 8260B	2-Hexanone (MBK)
GC-MS	EPA 8260B	Hexachlorobutadiene
GC-MS	EPA 8260B	Iodomethane
GC-MS	EPA 8260B	Isopropylbenzene
GC-MS	EPA 8260B	p-Isopropyltoluene
GC-MS	EPA 8260B	Methylene Chloride
GC-MS	EPA 8260B	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 8260B	tert-Butyl methyl ether
GC-MS	EPA 8260B	Naphthalene
GC-MS	EPA 8260B	n-Propylbenzene
GC-MS	EPA 8260B	Styrene
GC-MS	EPA 8260B	tert-Amyl methyl ether (TAME)
GC-MS	EPA 8260B	1,1,1,2-Tetrachloroethane
GC-MS	EPA 8260B	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B	Tetrachloroethene
GC-MS	EPA 8260B	Toluene
GC-MS	EPA 8260B	1,1,1-Trichloroethane
GC-MS	EPA 8260B	1,1,2-Trichloroethane
GC-MS	EPA 8260B	1,2,3-Trichlorobenzene
GC-MS	EPA 8260B	1,2,4-Trichlorobenzene
GC-MS	EPA 8260B	Trichloroethene
GC-MS	EPA 8260B	Trichlorofluoromethane
GC-MS	EPA 8260B	1,2,3-Trichloropropane
GC-MS	EPA 8260B	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 8260B	1,2,4-Trimethylbenzene
GC-MS	EPA 8260B	1,3,5-Trimethylbenzene
GC-MS	EPA 8260B	Vinyl Acetate
GC-MS	EPA 8260B	Vinyl Chloride
GC-MS	EPA 8260B	m-Xylene & p-xylene
GC-MS	EPA 8260B	o-Xylene
GC-MS	EPA 8260B	2-Butanol
GC-MS	EPA 8260B	Cyclohexane
GC-MS	EPA 8260B	1,4-Dioxane
GC-MS	EPA 8260B	2-Chloro-1,1,1-trifluoroethane
GC-MS	EPA 8260B	Chlorotrifluoroethylene
GC-MS	EPA 8260B	cis-1,4-Dichloro-2-butene
GC-MS	EPA 8260B	Ethanol
GC-MS	EPA 8260B	Ethyl Methacrylate
GC-MS	EPA 8260B	Isobutyl Alcohol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B	Methacrylonitrile
GC-MS	EPA 8260B	Methyl Methacrylate
GC-MS	EPA 8260B	Pentachloroethane
GC-MS	EPA 8260B	Propionitrile
GC-MS	EPA 8260B	Sec-Propyl alcohol
GC-MS	EPA 8260B	Tetrahydrofuran
GC-MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC-MS	EPA 8260B SIM	Benzene
GC-MS	EPA 8260B SIM	Carbon tetrachloride
GC-MS	EPA 8260B SIM	Chloroform
GC-MS	EPA 8260B SIM	Chloromethane
GC-MS	EPA 8260B SIM	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B SIM	1,2-Dibromoethane
GC-MS	EPA 8260B SIM	1,2-Dichloroethane
GC-MS	EPA 8260B SIM	1,1-Dichloroethene
GC-MS	EPA 8260B SIM	cis-1,2-Dichloroethene
GC-MS	EPA 8260B SIM	trans-1,2-Dichloroethene
GC-MS	EPA 8260B SIM	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B SIM	Tetrachloroethene
GC-MS	EPA 8260B SIM	1,1,1-Trichloroethane
GC-MS	EPA 8260B SIM	1,1,2-Trichloroethane
GC-MS	EPA 8260B SIM	Trichloroethene
GC-MS	EPA 8260B SIM	1,2,3-Trichloropropane
GC-MS	EPA 8260B SIM	Vinyl Chloride
GC-MS	EPA 8260B SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	Acenaphthene
GC-MS	EPA 8270C / 8270D	Acenaphthylene
GC-MS	EPA 8270C / 8270D	Aniline
GC-MS	EPA 8270C / 8270D	Anthracene
GC-MS	EPA 8270C / 8270D	Azobenzene
GC-MS	EPA 8270C / 8270D	Benzidine
GC-MS	EPA 8270C / 8270D	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzoic Acid
GC-MS	EPA 8270C / 8270D	Benzyl Alcohol
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	bis(2-chloroethoxy)methane
GC-MS	EPA 8270C / 8270D	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-chloroisopropyl)ether

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)adipate
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D	4-Bromophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D	Carbazole
GC-MS	EPA 8270C / 8270D	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D	4-Chloroaniline
GC-MS	EPA 8270C / 8270D	2-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	2-Chlorophenol
GC-MS	EPA 8270C / 8270D	4-Chlorophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Chrysene
GC-MS	EPA 8270C / 8270D	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D	Dibenzofuran
GC-MS	EPA 8270C / 8270D	1,2-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	3,3'-Dichlorobenzidine
GC-MS	EPA 8270C / 8270D	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D	Diethylphthalate
GC-MS	EPA 8270C / 8270D	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	Dimethylphthalate
GC-MS	EPA 8270C / 8270D	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D	4,6-Dinitro-2-methylphenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrophenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	2-6-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	Di-n-octylphthalate
GC-MS	EPA 8270C / 8270D	Fluoranthene
GC-MS	EPA 8270C / 8270D	Fluorene
GC-MS	EPA 8270C / 8270D	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D	Hexachlorobutadiene
GC-MS	EPA 8270C / 8270D	Hexachlorocyclopentadiene
GC-MS	EPA 8270C / 8270D	Hexachloroethane
GC-MS	EPA 8270C / 8270D	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D	Isophorone
GC-MS	EPA 8270C / 8270D	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D	2-Methylphenol
GC-MS	EPA 8270C / 8270D	4-Methylphenol
GC-MS	EPA 8270C / 8270D	Naphthalene
GC-MS	EPA 8270C / 8270D	2-Nitroaniline

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	3-Nitroaniline
GC-MS	EPA 8270C / 8270D	4-Nitroaniline
GC-MS	EPA 8270C / 8270D	Nitrobenzene
GC-MS	EPA 8270C / 8270D	2-Nitrophenol
GC-MS	EPA 8270C / 8270D	4-Nitrophenol
GC-MS	EPA 8270C / 8270D	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D	n-Nitrosodiphenylamine
GC-MS	EPA 8270C / 8270D	Pentachlorophenol
GC-MS	EPA 8270C / 8270D	Perylene
GC-MS	EPA 8270C / 8270D	Phenanthrene
GC-MS	EPA 8270C / 8270D	Phenol
GC-MS	EPA 8270C / 8270D	Pyrene
GC-MS	EPA 8270C / 8270D	Pyridine
GC-MS	EPA 8270C / 8270D	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 8270C / 8270D	1,2,4-Trichlorobenzene
GC-MS	EPA 8270C / 8270D	2,3,4-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D	1,2,4,5-Tetrachlorobenzene
GC-MS	EPA 8270C / 8270D	1,3,5-Trinitrobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dinitrobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	1,4-Naphthoquinone
GC-MS	EPA 8270C / 8270D	1-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	1-Naphthylamine
GC-MS	EPA 8270C / 8270D	2,6-Dichlorophenol
GC-MS	EPA 8270C / 8270D	2-acetylaminofluorene
GC-MS	EPA 8270C / 8270D	2-Naphthylamine
GC-MS	EPA 8270C / 8270D	2-Picoline
GC-MS	EPA 8270C / 8270D	3,3-Dimethylbenzidine
GC-MS	EPA 8270C / 8270D	3,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3,5-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3,5-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3-Methylchlolanthrene
GC-MS	EPA 8270C / 8270D	4-Aminobiphenyl
GC-MS	EPA 8270C / 8270D	4-Nitroquinoline-N-oxide
GC-MS	EPA 8270C / 8270D	5-Nitro-o-toluidine
GC-MS	EPA 8270C / 8270D	7,12-Dimethylben(a)anthracene
GC-MS	EPA 8270C / 8270D	a,a-dimethylphenethylamine
GC-MS	EPA 8270C / 8270D	Acetophenone

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	Aramite
GC-MS	EPA 8270C / 8270D	Atrazine
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	Chlorobenzilate
GC-MS	EPA 8270C / 8270D	Diallate
GC-MS	EPA 8270C / 8270D	Dibenzo(a,j)acridine
GC-MS	EPA 8270C / 8270D	Dimethoate
GC-MS	EPA 8270C / 8270D	Dinoseb
GC-MS	EPA 8270C / 8270D	Diphenyl ether
GC-MS	EPA 8270C / 8270D	Disulfoton
GC-MS	EPA 8270C / 8270D	Ethyl methacrylate
GC-MS	EPA 8270C / 8270D	Ethyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Ethyl parathion
GC-MS	EPA 8270C / 8270D	Famphur
GC-MS	EPA 8270C / 8270D	Hexachlorophene
GC-MS	EPA 8270C / 8270D	Hexachloropropene
GC-MS	EPA 8270C / 8270D	Isodrin
GC-MS	EPA 8270C / 8270D	Isosafrole
GC-MS	EPA 8270C / 8270D	kepone
GC-MS	EPA 8270C / 8270D	Methapyrilene
GC-MS	EPA 8270C / 8270D	Methyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Methyl parathion
GC-MS	EPA 8270C / 8270D	N-nitrosodiethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosodi-n-butylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomethylethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomorpholine
GC-MS	EPA 8270C / 8270D	N-Nitrosopiperdine
GC-MS	EPA 8270C / 8270D	N-Nitrosopyrrolidine
GC-MS	EPA 8270C / 8270D	O,O,O-triethyl phosphorothi
GC-MS	EPA 8270C / 8270D	o-toluidine
GC-MS	EPA 8270C / 8270D	p-Dimethylaminoazobenze
GC-MS	EPA 8270C / 8270D	Pentachlorobenzene
GC-MS	EPA 8270C / 8270D	Pentachloroethane
GC-MS	EPA 8270C / 8270D	Pentachloronitrobenzene
GC-MS	EPA 8270C / 8270D	Phenacetin
GC-MS	EPA 8270C / 8270D	Phorate
GC-MS	EPA 8270C / 8270D	p-phenylenediamine
GC-MS	EPA 8270C / 8270D	Pronamide
GC-MS	EPA 8270C / 8270D	Safrole
GC-MS	EPA 8270C / 8270D	Sulfotepp
GC-MS	EPA 8270C / 8270D	Thionazin
GC-MS	EPA 8270C / 8270D SIM	Acenaphthene
GC-MS	EPA 8270C / 8270D SIM	Acenaphthylene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D SIM	Anthracene
GC-MS	EPA 8270C / 8270D SIM	Azobenzene
GC-MS	EPA 8270C / 8270D SIM	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D SIM	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D SIM	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Biphenyl
GC-MS	EPA 8270C / 8270D SIM	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D SIM	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D SIM	Carbazole
GC-MS	EPA 8270C / 8270D SIM	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D SIM	2-Chlorophenol
GC-MS	EPA 8270C / 8270D SIM	Chrysene
GC-MS	EPA 8270C / 8270D SIM	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D SIM	Fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Fluorene
GC-MS	EPA 8270C / 8270D SIM	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D SIM	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D SIM	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D SIM	Naphthalene
GC-MS	EPA 8270C / 8270D SIM	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D SIM	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D SIM	Pentachlorophenol
GC-MS	EPA 8270C / 8270D SIM	Perylene
GC-MS	EPA 8270C / 8270D SIM	Phenanthrene
GC-MS	EPA 8270C / 8270D SIM	Phenol
GC-MS	EPA 8270C / 8270D SIM	Pyrene
GC-MS	EPA 8270C / 8270D SIM	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D SIM	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D SIM	Diethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Dimethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D SIM	Di-n-octylphthalate

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g,h,i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenzo(a,h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 8330A	HMX
HPLC	EPA 8330A	RDX
HPLC	EPA 8330A	1,3,5-TNB
HPLC	EPA 8330A	1,3-DNB
HPLC	EPA 8330A	Tetryl
HPLC	EPA 8330A	Nitrobenzene
HPLC	EPA 8330A	2,4,6-TNT
HPLC	EPA 8330A	4-AM-2,6-DNT
HPLC	EPA 8330A	2-AM-4,6-DNT
HPLC	EPA 8330A	2,6-DNT
HPLC	EPA 8330A	2,4-DNT
HPLC	EPA 8330A	2-Nitrotoluene
HPLC	EPA 8330A	4-Nitrotoluene
HPLC	EPA 8330A	3-Nitrotoluene
HPLC	EPA 8330A	3,5-Dinitroaniline
HPLC	EPA 8330A	2,4-Diamino-6-nitrotoluene
HPLC	EPA 8330A	2,6-Diamino-4-nitrotoluene
HPLC	EPA 8330A	3,5-Dinitroaniline
HPLC	EPA 8330A	Picric Acid
HPLC	EPA 8332	Nitroglycerine
HPLC	EPA 8332	PETN
Spectrometric	EPA 9014	Cyanide
Electrode	EPA 9040C	pH
Electrode	EPA 9045D	pH
IC	EPA 9056 / 9056A	Bromate

Non-Potable Water		
Technology	**Method**	**Analyte**
IC	EPA 9056 / 9056A	Bromide
IC	EPA 9056 / 9056A	Chloride
IC	EPA 9056 / 9056A	Fluoride
IC	EPA 9056 / 9056A	Nitrate
IC	EPA 9056 / 9056A	Nitrite
IC	EPA 9056 / 9056A	Phosphate
IC	EPA 9056 / 9056A	Sulfate
Combustion-IR	EPA 9060	TOC
Spectrometric	EPA 9065	Phenols
Gravimetric	EPA 9070	Oil & Grease
Gravimetric	EPA 9071B	Oil & Grease
GC	RSK175	Methane
GC	RSK175	Acetylene
GC	RSK175	Ethylene
GC	RSK175	Ethane
GC	RSK175	Propane
GC	RSK175	Carbon dioxide
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NOrgC	TKN
Spectrometric	SM4500-PE	Phosphorus
Turbidimetric	SM 2130B	Turbidity
Titrimetric	SM 2320B	Alkalinity
Titrimetric	SM 2340C	Hardness
Platinum Electrode	SM 2510B	Specific Conductance
Gravimetric	SM 2540C	TDS
Gravimetric	SM 2540D	TSS
Gravimetric	SM 2540B	Total Residue
Combustion-IR	SM5310	TOC
Spectrometric	SM3500-FeD	Ferrous iron
Titrimetric	SM4500-Cl B	Total Residual Chlorine
Spectrometric	SM4500CNE	Cyanide
Spectrometric	SM4500-NO2B	Nitrite-N
Spectrometric	SM4500-NO3E	Nitrate-N
Spectrometric	SM4500PE	Ortho-phosphate
Spectrometric	SM4500-PE(PB5)	Phosphorus
Spectrometric	SM4500-S2D	Sulfide
Titrimetric	SM4500-S2F	Sulfide
Spectrometric	SM4500-SiO2C	Silica
Electrode	SM5210B	BOD
Spectrometric	SM5220B	COD
Combustion-IR	SM 5310B	TOC
Spectrometric	SM5540C	Surfactants (MBAS)

Non-Potable Water		
Technology	**Method**	**Analyte**
Distillation	EPA 9010C	Cyanide
MicroDistillation	QuickChem 10-204-00-1-X	Cyanide
ICP/ICP-MS	SM2340B	Hardness
Preparation	**Method**	**Type**
Purge & Trap	EPA 5030B	Volatiles Prep
Acid Digestion	EPA 3005A / EPA 3010A / EPA 200.8	Metals Prep
Continuous Liquid-Liquid	EPA 3520C	Organic Extraction
Separatory Funnel	EPA 3510B	Organic Extraction
Waste Dilution	EPA 3580A	Organic Extraction
TCLP	EPA 1311	Leaching
SPLP	EPA 1312	Leaching

Drinking Water		
Technology	**Method**	**Analyte**
Platinum Electrode	EPA 120.1	Specific Conductance
Electrode	EPA 150.1	pH
Gravimetric	EPA 160.1	TDS
Gravimetric	EPA 160.2	TSS
Gravimetric	EPA 160.3	Total Residue
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium

Drinking Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc
IC	EPA 218.6	Hexavalent Chromium
Cold Vapor	EPA 245.1	Mercury
IC	EPA 300.0	Bromate
IC	EPA 300.0	Bromide
IC	EPA 300.0	Chloride
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Phosphate
IC	EPA 300.0	Sulfate
IC	EPA 300M	Acetate
IC	EPA 300M	Butyrate
IC	EPA 300M	Lactate
IC	EPA 300M	Propionate
IC	EPA 300M	Pyruvate
IC	EPA314.0	Perchlorate
Spectrometric	EPA 335.2	Cyanide
Spectrometric	EPA 350.2	Ammonia
Spectrometric	EPA 351.3	TKN
Spectrometric	EPA 352.1	Nitrate-N
Spectrometric	EPA 353.3	Nitrate-N
Spectrometric	EPA 354.1	Nitrite-N
Spectrometric	EPA 365.2	Ortho-phosphate
Spectrometric	EPA 365.2	Phosphorus
Spectrometric	EPA 370.1	Silica
Titrimetric	EPA 376.2	Sulfide
Spectrometric	EPA 410.4	COD
Combustion-IR	EPA 415.1	TOC
Spectrometric	EPA 420.1	Phenols
GC	EPA 504.1	DBCP
GC	EPA 504.1	EDB
GC-MS	EPA 524.2	Acetone

Drinking Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 524.2	Benzene
GC-MS	EPA 524.2	Bromobenzene
GC-MS	EPA 524.2	Bromochloromethane
GC-MS	EPA 524.2	Bromodichloromethane
GC-MS	EPA 524.2	Bromoform
GC-MS	EPA 524.2	Bromomethane
GC-MS	EPA 524.2	tert-Butyl alcohol
GC-MS	EPA 524.2	2-Butanone (MEK)
GC-MS	EPA 524.2	n-Butylbenzene
GC-MS	EPA 524.2	sec-Butylbenzene
GC-MS	EPA 524.2	tert-Butylbenzene
GC-MS	EPA 524.2	Carbon disulfide
GC-MS	EPA 524.2	Carbon tetrachloride
GC-MS	EPA 524.2	Chlorobenzene
GC-MS	EPA 524.2	Chloroethane
GC-MS	EPA 524.2	Chloroform
GC-MS	EPA 524.2	Chloromethane
GC-MS	EPA 524.2	2-Chlorotoluene
GC-MS	EPA 524.2	4-Chlorotoluene
GC-MS	EPA 524.2	Dibromochloromethane
GC-MS	EPA 524.2	1,2-Dibromo-3-chloropropane
GC-MS	EPA 524.2	1,2-Dibromoethane
GC-MS	EPA 524.2	Dibromomethane
GC-MS	EPA 524.2	1,1-Dichloroethane
GC-MS	EPA 524.2	1,2-Dichloroethane
GC-MS	EPA 524.2	1,2-Dichlorobenzene
GC-MS	EPA 524.2	1,3-Dichlorobenzene
GC-MS	EPA 524.2	1,4-Dichlorobenzene
GC-MS	EPA 524.2	Dichlorodifluoromethane
GC-MS	EPA 524.2	1,1-Dichloroethene
GC-MS	EPA 524.2	cis-1,2-Dichloroethene
GC-MS	EPA 524.2	trans-1,2-Dichloroethene
GC-MS	EPA 524.2	1,1-Dichloropropene
GC-MS	EPA 524.2	1,2-Dichloropropane
GC-MS	EPA 524.2	1,3-Dichloropropane
GC-MS	EPA 524.2	2,2-Dichloropropane
GC-MS	EPA 524.2	cis-1,3-Dichloropropene
GC-MS	EPA 524.2	trans-1,3-Dichloropropene
GC-MS	EPA 524.2	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 524.2	Ethylbenzene
GC-MS	EPA 524.2	2-Hexanone (MBK)

Drinking Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 524.2	Hexachlorobutadiene
GC-MS	EPA 524.2	Isopropyl ether (DIPE)
GC-MS	EPA 524.2	Isopropylbenzene
GC-MS	EPA 524.2	p-Isopropyltoluene
GC-MS	EPA 524.2	Methylene Chloride
GC-MS	EPA 524.2	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 524.2	tert-Butyl methyl ether
GC-MS	EPA 524.2	Naphthalene
GC-MS	EPA 524.2	n-Propylbenzene
GC-MS	EPA 524.2	Styrene
GC-MS	EPA 524.2	tert-Amyl methyl ether (TAME)
GC-MS	EPA 524.2	1,1,1,2-Tetrachloroethane
GC-MS	EPA 524.2	1,1,2,2-Tetrachloroethane
GC-MS	EPA 524.2	Tetrachloroethene
GC-MS	EPA 524.2	Toluene
GC-MS	EPA 524.2	1,1,1-Trichloroethane
GC-MS	EPA 524.2	1,1,2-Trichloroethane
GC-MS	EPA 524.2	1,2,3-Trichlorobenzene
GC-MS	EPA 524.2	1,2,4-Trichlorobenzene
GC-MS	EPA 524.2	Trichloroethene
GC-MS	EPA 524.2	Trichlorofluoromethane
GC-MS	EPA 524.2	1,2,3-Trichloropropane
GC-MS	EPA 524.2	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 524.2	1,2,4-Trimethylbenzene
GC-MS	EPA 524.2	1,3,5-Trimethylbenzene
GC-MS	EPA 524.2	Vinyl Chloride
GC-MS	EPA 524.2	m-Xylene & p-xylene
GC-MS	EPA 524.2	o-Xylene
HPLC-MS	EPA 6850	Perchlorate
ICP/ICP-MS by Calculation	SM 2340B	Hardness
Titrimetric	SM 2340C	Hardness
Platinum Electrode	SM 2510B	Specific Conductance
Gravimetric	SM 2540B	Total Residue
Gravimetric	SM 2540C	TDS
Gravimetric	SM 2540D	TSS
Spectrometric	SM 3500-FeD	Ferrous Iron
Spectrometric	SM 4500-CNE	Cyanide
Spectrometric	SM 4500-NH3C	Ammonia
Spectrometric	SM 4500-NH3F	Ammonia
Spectrometric	SM 4500-NO2B	Nitrite-N
Spectrometric	SM 4500-NO3E	Nitrate-N

Drinking Water		
Technology	**Method**	**Analyte**
Spectrometric	SM 4500-NOrgC	TKN
Spectrometric	SM 4500-PE	Ortho-phosphate
Spectrometric	SM 4500-PE(PB5)	Phosphorus
Titrimetric	SM 4500-S2D	Sulfide
Spectrometric	SM 4500-SiO2C	Silica
Spectrometric	SM 5220B	COD
Combustion-IR	SM 5310B	TOC
Spectrometric	SM 5540C	Surfactants
MicroDistillation	QuickChem 10-204-00-1-X	Cyanide

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	AK101	GRO
GC	AK102	DRO
GC	AK103	RRO
GC	AZ8015	DRO (C10-C22)
GC	AZ8015	ORO (C22-C32)
GC	RSK175	Methane
GC	RSK175	Acetylene
GC	RSK175	Ethylene
GC	RSK175	Ethane
GC	RSK175	Propane
GC	RSK175	Carbon dioxide
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NOrgC	TKN
Spectrometric	SM4500-PE(PB5)	Phosphorus
Titrimetric	Walkley Black	TOC
Electrode	EPA 9040C	pH
Electrode	EPA 9045D	pH
Spectrometric	EPA 9065	Phenols
Penskey-Martens	EPA 1010	Ignitability
ICP	EPA 6010B / 6010C	Aluminum
ICP	EPA 6010B / 6010C	Antimony
ICP	EPA 6010B / 6010C	Arsenic
ICP	EPA 6010B / 6010C	Barium
ICP	EPA 6010B / 6010C	Beryllium
ICP	EPA 6010B / 6010C	Boron
ICP	EPA 6010B / 6010C	Cadmium
ICP	EPA 6010B / 6010C	Calcium
ICP	EPA 6010B / 6010C	Chromium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	EPA 6010B / 6010C	Cobalt
ICP	EPA 6010B / 6010C	Copper
ICP	EPA 6010B / 6010C	Iron
ICP	EPA 6010B / 6010C	Lead
ICP	EPA 6010B / 6010C	Magnesium
ICP	EPA 6010B / 6010C	Manganese
ICP	EPA 6010B / 6010C	Molybdenum
ICP	EPA 6010B / 6010C	Nickel
ICP	EPA 6010B / 6010C	Potassium
ICP	EPA 6010B / 6010C	Selenium
ICP	EPA 6010B / 6010C	Silver
ICP	EPA 6010B / 6010C	Sodium
ICP	EPA 6010B / 6010C	Strontium
ICP	EPA 6010B / 6010C	Thallium
ICP	EPA 6010B / 6010C	Tin
ICP	EPA 6010B / 6010C	Titanium
ICP	EPA 6010B / 6010C	Vanadium
ICP	EPA 6010B / 6010C	Zinc
IPC-MS	EPA 6020A	Aluminum
IPC-MS	EPA 6020A	Antimony
IPC-MS	EPA 6020A	Arsenic
IPC-MS	EPA 6020A	Barium
IPC-MS	EPA 6020A	Beryllium
IPC-MS	EPA 6020A	Boron
IPC-MS	EPA 6020A	Cadmium
IPC-MS	EPA 6020A	Calcium
IPC-MS	EPA 6020A	Chromium
IPC-MS	EPA 6020A	Cobalt
IPC-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Zinc
HPLC-MS	EPA 6850	Perchlorate
Spectrometric	EPA 7196A	Hex. Chromium
IC	EPA 7199	Hex. Chromium
Cold-Vapor	EPA 7470A / 7471A / 7471B	Mercury
GC	EPA 8011	DBCP
GC	EPA 8011	EDB
GC	EPA 8015B / 8015C	Gasoline
GC	EPA 8015B / 8015C	Diesel
GC	EPA 8015B / 8015C	Motor Oil
GC	EPA 8015B / 8015C	JP5
GC	EPA 8015B / 8015C	Ethanol
GC	EPA 8015B / 8015C	Isopropanol
GC	EPA 8015B / 8015C	Diethylene Glycol
GC	EPA 8015B / 8015C	Ethylene Glycol
GC	EPA 8015B / 8015C	JP4
GC	EPA 8015B / 8015C	Methanol
GC	EPA 8015B / 8015C	Propylene Glycol
GC	EPA 8081A / 8081B	Aldrin
GC	EPA 8081A / 8081B	alpha-BHC
GC	EPA 8081A / 8081B	beta-BHC
GC	EPA 8081A / 8081B	delta-BHC
GC	EPA 8081A / 8081B	gamma-BHC (Lindane)
GC	EPA 8081A / 8081B	DDD (4,4)
GC	EPA 8081A / 8081B	DDE (4,4)
GC	EPA 8081A / 8081B	DDT (4,4)
GC	EPA 8081A / 8081B	Dieldrin
GC	EPA 8081A / 8081B	Endosulfan I
GC	EPA 8081A / 8081B	Endosulfan II
GC	EPA 8081A / 8081B	Endosulfan sulfate
GC	EPA 8081A / 8081B	Endrin
GC	EPA 8081A / 8081B	Endrin Aldehyde
GC	EPA 8081A / 8081B	Heptachlor
GC	EPA 8081A / 8081B	Heptachlor epoxide
GC	EPA 8081A / 8081B	Methoxychlor
GC	EPA 8081A / 8081B	alpha-Chlordane
GC	EPA 8081A / 8081B	gamma-Chlordane
GC	EPA 8081A / 8081B	Endrin Ketone
GC	EPA 8081A / 8081B	Toxaphene
GC	EPA 8081A / 8081B	Technical Chlordane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8081A / 8081B	cis-Nonachlor
GC	EPA 8081A / 8081B	DDD (2,4)
GC	EPA 8081A / 8081B	DDE (2,4)
GC	EPA 8081A / 8081B	DDT (2,4)
GC	EPA 8081A / 8081B	Mirex
GC	EPA 8081A / 8081B	Oxychlordane
GC	EPA 8081A / 8081B	trans-Nonachlor
GC	EPA 8082 / 8082A	PCB1016
GC	EPA 8082 / 8082A	PCB1221
GC	EPA 8082 / 8082A	PCB1232
GC	EPA 8082 / 8082A	PCB1242
GC	EPA 8082 / 8082A	PCB1248
GC	EPA 8082 / 8082A	PCB1254
GC	EPA 8082 / 8082A	PCB1260
GC	EPA 8082 / 8082A	PCB1262
GC	EPA 8082 / 8082A	PCB1268
GC	EPA 8082 / 8082A	PCB 8
GC	EPA 8082 / 8082A	PCB 18
GC	EPA 8082 / 8082A	PCB 28
GC	EPA 8082 / 8082A	PCB 44
GC	EPA 8082 / 8082A	PCB 52
GC	EPA 8082 / 8082A	PCB 66
GC	EPA 8082 / 8082A	PCB 77
GC	EPA 8082 / 8082A	PCB 81
GC	EPA 8082 / 8082A	PCB 101
GC	EPA 8082 / 8082A	PCB 105
GC	EPA 8082 / 8082A	PCB 110
GC	EPA 8082 / 8082A	PCB 114
GC	EPA 8082 / 8082A	PCB 118
GC	EPA 8082 / 8082A	PCB 123
GC	EPA 8082 / 8082A	PCB 126
GC	EPA 8082 / 8082A	PCB 128
GC	EPA 8082 / 8082A	PCB 138
GC	EPA 8082 / 8082A	PCB 153
GC	EPA 8082 / 8082A	PCB 156
GC	EPA 8082 / 8082A	PCB 157
GC	EPA 8082 / 8082A	PCB 167
GC	EPA 8082 / 8082A	PCB 169
GC	EPA 8082 / 8082A	PCB 170
GC	EPA 8082 / 8082A	PCB 180
GC	EPA 8082 / 8082A	PCB 187
GC	EPA 8082 / 8082A	PCB 189
GC	EPA 8082 / 8082A	PCB 195

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8082 / 8082A	PCB 206
GC	EPA 8082 / 8082A	PCB 209
GC	EPA 8141A / 8141B	Azinphos-methyl
GC	EPA 8141A / 8141B	Bolstar
GC	EPA 8141A / 8141B	Chlorpyrifos
GC	EPA 8141A / 8141B	Coumaphos
GC	EPA 8141A / 8141B	Demeton
GC	EPA 8141A / 8141B	Diazinon
GC	EPA 8141A / 8141B	Dichlorvos
GC	EPA 8141A / 8141B	Disulfoton
GC	EPA 8141A / 8141B	Ethoprop
GC	EPA 8141A / 8141B	Fensulfothion
GC	EPA 8141A / 8141B	Fenthion
GC	EPA 8141A / 8141B	Merphos
GC	EPA 8141A / 8141B	Mevinphos
GC	EPA 8141A / 8141B	Naled
GC	EPA 8141A / 8141B	Methyl Parathion
GC	EPA 8141A / 8141B	Phorate
GC	EPA 8141A / 8141B	Ronnel
GC	EPA 8141A / 8141B	Stirophos
GC	EPA 8141A / 8141B	Tokuthion
GC	EPA 8141A / 8141B	Trichloronate
GC	EPA 8141A / 8141B	Dimethoate
GC	EPA 8141A / 8141B	EPN
GC	EPA 8141A / 8141B	Famphur
GC	EPA 8141A / 8141B	Malathion
GC	EPA 8141A / 8141B	Ethyl Parathion
GC	EPA 8141A / 8141B	O,O,O-Triethylphosphorothioate
GC	EPA 8141A / 8141B	Sulfotepp
GC	EPA 8141A / 8141B	Thionazin
GC	EPA 8141A / 8141B	Tributyl Phosphate
GC-MS	EPA 8260B	Acetone
GC-MS	EPA 8260B	Acrolein
GC-MS	EPA 8260B	Acrylonitrile
GC-MS	EPA 8260B	Benzene
GC-MS	EPA 8260B	Bromobenzene
GC-MS	EPA 8260B	Bromochloromethane
GC-MS	EPA 8260B	Bromodichloromethane
GC-MS	EPA 8260B	Bromoform
GC-MS	EPA 8260B	Bromomethane
GC-MS	EPA 8260B	tert-Butyl alcohol
GC-MS	EPA 8260B	2-Butanone (MEK)
GC-MS	EPA 8260B	n-Butylbenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B	sec-Butylbenzene
GC-MS	EPA 8260B	tert-Butylbenzene
GC-MS	EPA 8260B	Carbon disulfide
GC-MS	EPA 8260B	Carbon tetrachloride
GC-MS	EPA 8260B	Chlorobenzene
GC-MS	EPA 8260B	2-Chloroethyl vinyl ether
GC-MS	EPA 8260B	Chloroethane
GC-MS	EPA 8260B	Chloroform
GC-MS	EPA 8260B	1-Chlorohexane
GC-MS	EPA 8260B	Chloromethane
GC-MS	EPA 8260B	2-Chlorotoluene
GC-MS	EPA 8260B	4-Chlorotoluene
GC-MS	EPA 8260B	Isopropyl ether (DIPE)
GC-MS	EPA 8260B	Dibromochloromethane
GC-MS	EPA 8260B	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B	1,2-Dibromoethane
GC-MS	EPA 8260B	Dibromomethane
GC-MS	EPA 8260B	1,1-Dichloroethane
GC-MS	EPA 8260B	1,2-Dichloroethane
GC-MS	EPA 8260B	1,2-Dichlorobenzene
GC-MS	EPA 8260B	1,3-Dichlorobenzene
GC-MS	EPA 8260B	trans-1,4-Dichloro-2-Butene
GC-MS	EPA 8260B	1,4-Dichlorobenzene
GC-MS	EPA 8260B	Dichlorodifluoromethane
GC-MS	EPA 8260B	1,1-Dichloroethene
GC-MS	EPA 8260B	cis-1,2-Dichloroethene
GC-MS	EPA 8260B	trans-1,2-Dichloroethene
GC-MS	EPA 8260B	Dichlorofluoromethane
GC-MS	EPA 8260B	1,1-Dichloropropene
GC-MS	EPA 8260B	1,2-Dichloropropane
GC-MS	EPA 8260B	1,3-Dichloropropane
GC-MS	EPA 8260B	2,2-Dichloropropane
GC-MS	EPA 8260B	cis-1,3-Dichloropropene
GC-MS	EPA 8260B	trans-1,3-Dichloropropene
GC-MS	EPA 8260B	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 8260B	Ethyl Methacrylate
GC-MS	EPA 8260B	Ethylbenzene
GC-MS	EPA 8260B	2-Hexanone (MBK)
GC-MS	EPA 8260B	Hexachlorobutadiene
GC-MS	EPA 8260B	Iodomethane
GC-MS	EPA 8260B	Isopropylbenzene
GC-MS	EPA 8260B	p-Isopropyltoluene
GC-MS	EPA 8260B	Methylene Chloride

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 8260B	tert-Butyl methyl ether
GC-MS	EPA 8260B	Naphthalene
GC-MS	EPA 8260B	n-Propylbenzene
GC-MS	EPA 8260B	Styrene
GC-MS	EPA 8260B	tert-Amyl methyl ether (TAME)
GC-MS	EPA 8260B	1,1,1,2-Tetrachloroethane
GC-MS	EPA 8260B	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B	Tetrachloroethene
GC-MS	EPA 8260B	Toluene
GC-MS	EPA 8260B	1,1,1-Trichloroethane
GC-MS	EPA 8260B	1,1,2-Trichloroethane
GC-MS	EPA 8260B	1,2,3-Trichlorobenzene
GC-MS	EPA 8260B	1,2,4-Trichlorobenzene
GC-MS	EPA 8260B	Trichloroethene
GC-MS	EPA 8260B	Trichlorofluoromethane
GC-MS	EPA 8260B	1,2,3-Trichloropropane
GC-MS	EPA 8260B	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 8260B	1,2,4-Trimethylbenzene
GC-MS	EPA 8260B	1,3,5-Trimethylbenzene
GC-MS	EPA 8260B	Vinyl Acetate
GC-MS	EPA 8260B	Vinyl Chloride
GC-MS	EPA 8260B	m-Xylene & p-xylene
GC-MS	EPA 8260B	o-Xylene
GC-MS	EPA 8260B	2-Butanol
GC-MS	EPA 8260B	Cyclohexane
GC-MS	EPA 8260B	1,4-Dioxane
GC-MS	EPA 8260B	2-Chloro-1,1,1-trifluoroethane
GC-MS	EPA 8260B	2-Chloro-1,1,1-trifluoroethane
GC-MS	EPA 8260B	Chlorotrifluoroethylene
GC-MS	EPA 8260B	cis-1,4-Dichloro-2-butene
GC-MS	EPA 8260B	Ethanol
GC-MS	EPA 8260B	Ethyl Methacrylate
GC-MS	EPA 8260B	Isobutyl Alcohol
GC-MS	EPA 8260B	Methacrylonitrile
GC-MS	EPA 8260B	Methyl Methacrylate
GC-MS	EPA 8260B	Pentachloroethane
GC-MS	EPA 8260B	Propionitrile
GC-MS	EPA 8260B	Sec-Propyl alcohol
GC-MS	EPA 8260B	Tetrahydrofuran
GC-MS	EPA 8260B	trans-1,4-Dichloro-2-butene
GC-MS	EPA 8260B SIM	Benzene
GC-MS	EPA 8260B SIM	Carbon tetrachloride

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B SIM	Chloroform
GC-MS	EPA 8260B SIM	Chloromethane
GC-MS	EPA 8260B SIM	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B SIM	1,2-Dibromoethane
GC-MS	EPA 8260B SIM	1,2-Dichloroethane
GC-MS	EPA 8260B SIM	1,1-Dichloroethene
GC-MS	EPA 8260B SIM	cis-1,2-Dichloroethene
GC-MS	EPA 8260B SIM	trans-1,2-Dichloroethene
GC-MS	EPA 8260B SIM	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B SIM	Tetrachloroethene
GC-MS	EPA 8260B SIM	1,1,1-Trichloroethane
GC-MS	EPA 8260B SIM	1,1,2-Trichloroethane
GC-MS	EPA 8260B SIM	Trichloroethene
GC-MS	EPA 8260B SIM	1,2,3-Trichloropropane
GC-MS	EPA 8260B SIM	Vinyl Chloride
GC-MS	EPA 8260B SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	Acenaphthene
GC-MS	EPA 8270C / 8270D	Acenaphthylene
GC-MS	EPA 8270C / 8270D	Aniline
GC-MS	EPA 8270C / 8270D	Anthracene
GC-MS	EPA 8270C / 8270D	Azobenzene
GC-MS	EPA 8270C / 8270D	Benzidine
GC-MS	EPA 8270C / 8270D	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzoic Acid
GC-MS	EPA 8270C / 8270D	Benzyl Alcohol
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	bis(2-chloroethoxy)methane
GC-MS	EPA 8270C / 8270D	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-chloroisopropyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)adipate
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D	4-Bromophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D	Carbazole
GC-MS	EPA 8270C / 8270D	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D	4-Chloroaniline
GC-MS	EPA 8270C / 8270D	2-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	2-Chlorophenol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	4-Chlorophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Chrysene
GC-MS	EPA 8270C / 8270D	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D	Dibenzofuran
GC-MS	EPA 8270C / 8270D	1,2-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	3,3'-Dichlorobenzidine
GC-MS	EPA 8270C / 8270D	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D	Diethylphthalate
GC-MS	EPA 8270C / 8270D	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	Dimethylphthalate
GC-MS	EPA 8270C / 8270D	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D	4,6-Dinitro-2-methylphenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrophenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	2-6-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	Di-n-octylphthalate
GC-MS	EPA 8270C / 8270D	Fluoranthene
GC-MS	EPA 8270C / 8270D	Fluorene
GC-MS	EPA 8270C / 8270D	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D	Hexachlorobutadiene
GC-MS	EPA 8270C / 8270D	Hexachlorocyclopentadiene
GC-MS	EPA 8270C / 8270D	Hexachloroethane
GC-MS	EPA 8270C / 8270D	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D	Isophorone
GC-MS	EPA 8270C / 8270D	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D	2-Methylphenol
GC-MS	EPA 8270C / 8270D	4-Methylphenol
GC-MS	EPA 8270C / 8270D	Naphthalene
GC-MS	EPA 8270C / 8270D	2-Nitroaniline
GC-MS	EPA 8270C / 8270D	3-Nitroaniline
GC-MS	EPA 8270C / 8270D	4-Nitroaniline
GC-MS	EPA 8270C / 8270D	Nitrobenzene
GC-MS	EPA 8270C / 8270D	2-Nitrophenol
GC-MS	EPA 8270C / 8270D	4-Nitrophenol
GC-MS	EPA 8270C / 8270D	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D	n-Nitrosodiphenylamine
GC-MS	EPA 8270C / 8270D	Pentachlorophenol

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	Perylene
GC-MS	EPA 8270C / 8270D	Phenanthrene
GC-MS	EPA 8270C / 8270D	Phenol
GC-MS	EPA 8270C / 8270D	Pyrene
GC-MS	EPA 8270C / 8270D	Pyridine
GC-MS	EPA 8270C / 8270D	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 8270C / 8270D	1,2,4-Trichlorobenzene
GC-MS	EPA 8270C / 8270D	2,3,4-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D	1,2,4,5-Tetrachlorobenzene
GC-MS	EPA 8270C / 8270D	1,3,5-Trinitrobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dinitrobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	1,4-Naphthoquinone
GC-MS	EPA 8270C / 8270D	1-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	1-Naphthylamine
GC-MS	EPA 8270C / 8270D	2,6-Dichlorophenol
GC-MS	EPA 8270C / 8270D	2-acetylaminofluorene
GC-MS	EPA 8270C / 8270D	2-Naphthylamine
GC-MS	EPA 8270C / 8270D	2-Picoline
GC-MS	EPA 8270C / 8270D	3,3-Dimethylbenzidine
GC-MS	EPA 8270C / 8270D	3,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3,5-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3,5-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3-Methylchlolanthrene
GC-MS	EPA 8270C / 8270D	4-Aminobiphenyl
GC-MS	EPA 8270C / 8270D	4-Nitroquinoline-N-oxide
GC-MS	EPA 8270C / 8270D	5-Nitro-o-toluidine
GC-MS	EPA 8270C / 8270D	7,12-Dimethylben(a)anthracene
GC-MS	EPA 8270C / 8270D	Acetophenone
GC-MS	EPA 8270C / 8270D	Aramite
GC-MS	EPA 8270C / 8270D	Atrazine
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	Chlorobenzilate
GC-MS	EPA 8270C / 8270D	Diallate
GC-MS	EPA 8270C / 8270D	Dibenzo(a,j)acridine
GC-MS	EPA 8270C / 8270D	Dimethoate
GC-MS	EPA 8270C / 8270D	Dinoseb
GC-MS	EPA 8270C / 8270D	Diphenyl ether
GC-MS	EPA 8270C / 8270D	Disulfoton

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	Ethyl methacrylate
GC-MS	EPA 8270C / 8270D	Ethyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Ethyl parathion
GC-MS	EPA 8270C / 8270D	Famphur
GC-MS	EPA 8270C / 8270D	Hexachlorophene
GC-MS	EPA 8270C / 8270D	Hexachloropropene
GC-MS	EPA 8270C / 8270D	Isodrin
GC-MS	EPA 8270C / 8270D	Isosafrole
GC-MS	EPA 8270C / 8270D	kepone
GC-MS	EPA 8270C / 8270D	Methapyrilene
GC-MS	EPA 8270C / 8270D	Methyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Methyl parathion
GC-MS	EPA 8270C / 8270D	N-nitrosodiethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosodi-n-butylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomethylethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomorpholine
GC-MS	EPA 8270C / 8270D	N-Nitrosopiperdine
GC-MS	EPA 8270C / 8270D	N-Nitrosopyrrolidine
GC-MS	EPA 8270C / 8270D	O,O,O-triethyl phosphorothi
GC-MS	EPA 8270C / 8270D	o-toluidine
GC-MS	EPA 8270C / 8270D	p-Dimethylaminoazobenze
GC-MS	EPA 8270C / 8270D	Pentachlorobenzene
GC-MS	EPA 8270C / 8270D	Pentachloroethane
GC-MS	EPA 8270C / 8270D	Pentachloronitrobenzene
GC-MS	EPA 8270C / 8270D	Phenacetin
GC-MS	EPA 8270C / 8270D	Phorate
GC-MS	EPA 8270C / 8270D	p-phenylenediamine
GC-MS	EPA 8270C / 8270D	Pronamide
GC-MS	EPA 8270C / 8270D	Safrole
GC-MS	EPA 8270C / 8270D	Sulfotepp
GC-MS	EPA 8270C / 8270D	Thionazin
GC-MS	EPA 8270C / 8270D SIM	Acenaphthene
GC-MS	EPA 8270C / 8270D SIM	Acenaphthylene
GC-MS	EPA 8270C / 8270D SIM	Anthracene
GC-MS	EPA 8270C / 8270D SIM	Azobenzene
GC-MS	EPA 8270C / 8270D SIM	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D SIM	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D SIM	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Biphenyl
GC-MS	EPA 8270C / 8270D SIM	bis(2-chloroethyl)ether

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D SIM	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D SIM	Carbazole
GC-MS	EPA 8270C / 8270D SIM	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D SIM	2-Chlorophenol
GC-MS	EPA 8270C / 8270D SIM	Chrysene
GC-MS	EPA 8270C / 8270D SIM	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D SIM	Fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Fluorene
GC-MS	EPA 8270C / 8270D SIM	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D SIM	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D SIM	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D SIM	Naphthalene
GC-MS	EPA 8270C / 8270D SIM	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D SIM	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D SIM	Pentachlorophenol
GC-MS	EPA 8270C / 8270D SIM	Perylene
GC-MS	EPA 8270C / 8270D SIM	Phenanthrene
GC-MS	EPA 8270C / 8270D SIM	Phenol
GC-MS	EPA 8270C / 8270D SIM	Pyrene
GC-MS	EPA 8270C / 8270D SIM	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D SIM	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D SIM	Diethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Dimethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D SIM	Di-n-octylphthalate
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g,h,i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	EPA 8310	Dibenzo(a,h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 8330A	HMX
HPLC	EPA 8330A	RDX
HPLC	EPA 8330A	1,3,5-TNB
HPLC	EPA 8330A	1,3-DNB
HPLC	EPA 8330A	Tetryl
HPLC	EPA 8330A	Nitrobenzene
HPLC	EPA 8330A	2,4,6-TNT
HPLC	EPA 8330A	4-AM-2,6-DNT
HPLC	EPA 8330A	2-AM-4,6-DNT
HPLC	EPA 8330A	2,6-DNT
HPLC	EPA 8330A	2,4-DNT
HPLC	EPA 8330A	2-Nitrotoluene
HPLC	EPA 8330A	4-Nitrotoluene
HPLC	EPA 8330A	3-Nitrotoluene
HPLC	EPA 8330A	3,5-Dinitroaniline
HPLC	EPA 8330A	2,4-Diamino-6-nitrotoluene
HPLC	EPA 8330A	2,6-Diamino-4-nitrotoluene
HPLC	EPA 8330A	3,5-Dinitroaniline
HPLC	EPA 8330A	Picric Acid
HPLC	EPA 8332	Nitroglycerine
HPLC	EPA 8332	PETN
Combustion-IR	EPA 9060	TOC
IC	EPA9056/9056A	Bromate
IC	EPA9056/9056A	Bromide
IC	EPA9056/9056A	Chloride
IC	EPA9056/9056A	Fluoride
IC	EPA9056/9056A	Nitrate
IC	EPA9056/9056A	Nitrite
IC	EPA9056/9056A	Phosphate
IC	EPA9056/9056A	Sulfate
GC	EPA 8151A	Acifluorfen
GC	EPA 8151A	Bentazon

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8151A	Chloramben
GC	EPA 8151A	2,4-D
GC	EPA 8151A	2,4-DB
GC	EPA 8151A	Dacthal
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	3,5 Dichlorobenzoic
GC	EPA 8151A	Dichlorprop
GC	EPA 8151A	Dinoseb
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	Pentachlorophenol
GC	EPA 8151A	Picloram
GC	EPA 8151A	Silvex
GC	EPA 8151A	2,4,5-T
Spectrometric	EPA 9014	Cyanide
GFAA	CA 939M	Organo Lead
Preparation	**Method**	**Type**
Purge &Trap	EPA 5030B / EPA 5035	Volatiles Prep
Acid Digestion	EPA 3010 / EPA 3050B	Metals Prep
Alkaline Digestion	EPA 3060A	Hexavalent Chrom
Soxhlet	EPA 3540C	Organic Extraction
Sonication	EPA 3520C / EPA 3550C	Organic Extraction
Waste Dilution	EPA 3580A	Organic Extraction
TCLP	EPA 1311	Leaching
SPLP	EPA 1312	Leaching
Floricil Clean-up	EPA 3520B	Extract Clean-Up
GPC Clean-up	EPA 3640A	Extract Clean-Up
Sulfur Clean-up	EPA 3660B	Extract Clean-Up
Acid/Permanganate Clean-up	EPA 3665A	Extract Clean-Up

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	1,1,1-trichloroethane
GC-MS	TO-15	1,1,2,2-tetrachloroethane
GC-MS	TO-15	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	TO-15	1,1,2-trichloroethane
GC-MS	TO-15	1,1-dichloroethane

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	1,1-Dichloroethene
GC-MS	TO-15	1,2,4-trichlorobenzene
GC-MS	TO-15	1,2,4-trimethylbenzene
GC-MS	TO-15	1,2-dibromoethane
GC-MS	TO-15	1,2-dichlorobenzene
GC-MS	TO-15	1,2-dichloroethane
GC-MS	TO-15	1,2-dichloroethene
GC-MS	TO-15	1,2-dichloropropane
GC-MS	TO-15	1,3,5-trimethylbenzene
GC-MS	TO-15	1,3-Butadiene
GC-MS	TO-15	1,3-Butadiene, 1,1,2,3,4,Hexachloro
GC-MS	TO-15	1,3-dichlorobenzene
GC-MS	TO-15	1,4-dichlorobenzene
GC-MS	TO-15	1,4-Dioxane
GC-MS	TO-15	2,2,4-Trimethylpentane
GC-MS	TO-15	4-Ethyltoluene
GC-MS	TO-15	Acetone
GC-MS	TO-15	Acrylonitrile
GC-MS	TO-15	Allyl Chloride
GC-MS	TO-15	Benzene
GC-MS	TO-15	Benzyl Chloride
GC-MS	TO-15	Bromodichloromethane
GC-MS	TO-15	Bromoform
GC-MS	TO-15	Bromomethane
GC-MS	TO-15	Carbon Disulfide
GC-MS	TO-15	Carbon Tetrachloride
GC-MS	TO-15	Chlorobenzene
GC-MS	TO-15	Chloroethane
GC-MS	TO-15	Chloroethene
GC-MS	TO-15	Chloroform
GC-MS	TO-15	Chloromethane
GC-MS	TO-15	cis-1,3-Dichloropropene
GC-MS	TO-15	Cyclohexane
GC-MS	TO-15	Dibromochloromethane
GC-MS	TO-15	Dichlorodifluoromethane
GC-MS	TO-15	Dichlorotetrafluoroethane
GC-MS	TO-15	Ethyl Acetate

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	Ethylbenzene
GC-MS	TO-15	Isopropyl Alcohol
GC-MS	TO-15	m+p-Xylene
GC-MS	TO-15	Methyl butyl Ketone
GC-MS	TO-15	Methyl Ethyl Ketone
GC-MS	TO-15	Methyl Isobutyl Ketone
GC-MS	TO-15	Methyl Tert-Butyl Ether
GC-MS	TO-15	Methylene Chloride
GC-MS	TO-15	n-Heptane
GC-MS	TO-15	n-Hexane
GC-MS	TO-15	o-Xylene
GC-MS	TO-15	Styrene
GC-MS	TO-15	Tetrachloroethylene
GC-MS	TO-15	Tetrahydrofuran
GC-MS	TO-15	Toluene
GC-MS	TO-15	Trans-1,2-Dichloroethene
GC-MS	TO-15	trans-1,3-Dichloropropene
GC-MS	TO-15	Trichloroethylene
GC-MS	TO-15	Trichloromonofluoromethan
GC-MS	TO-15	Vinyl Acetate
GC-MS	TO-15	Vinyl Bromide

Notes:

1) This laboratory offers commercial testing service.

Approved By: _____ Date: January 31, 2012

R. Douglas Leonard
Chief Technical Officer

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